EXPLORATION OF FACTORS IMPACTING
THE SELF-CARE OF ELDERS WITH DIABETES

By

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ABSTRACT

Aims: Elders with type 2 diabetes represent the faster growing demographic segment today, yet there is little known about the factors that influence their diabetes self care management. The factors (age related developmental deficits, health literacy, knowledge of diabetes as a disease, and prior attendance within a structured diabetes educational program) that most impact diabetes self care among this age group was determined from the literature. Seven research questions and three model hypothesis questions were posed to examine the relationships between these identified factors.

Method: The study was composed of 75 elders with type 2 diabetes who resided within two metropolitan regions in the Southwest. The elders were asked to perform manual dexterity tests, visual acuity examination, and tests of cognition along with answering questions in regard to their health literacy and knowledge of diabetes.

Results: Of all the factors examined only health literacy and cognitive reasoning ability were statistically significant to the measure of diabetes self care.
CHAPTER ONE
INTRODUCTION

Diabetes type 2 is increasing at an epidemic rate in the United States (Centers for Disease Control [CDC], 2002; National Institute of Health [NIH], 1999). It is currently one of the most frequently occurring chronic conditions in Western societies (Van der Bijl, van Poelgeest-Eeltink, & Shortridge-Baggett, 1999). The estimated societal health care costs, both directly and indirectly for diabetes and its related conditions, in 1992 were $45.2 billion dollars, and the total health care costs of diabetes rose to $98.2 billion dollars in 1998 (Currier, Morgan, & Peters, 1998; Jonsson, 1998; Selby, Ray, Zhong, & Colby, 1997). About 32 million Americans will be diagnosed as having diabetes by 2005, and approximately one-quarter of all U.S. health care dollars will be spent on this one disease and its related complications (Bertoni, Krup, Anderson, & Brancati, 2002).

Background

Diabetes and its complications occur among Americans of all ages and racial/ethnic groups, but the elderly and certain racial/ethnic groups are more commonly affected by the disease (NIH, 1999). Type 2 diabetes currently affects more than 16 million Americans, most of whom are over the age of 65 (Harris, Eastman, Cowie, Flegal, & Eberhardt, 1999). A full 20% of the population over the age of 65 have already been diagnosed with type 2 diabetes with an estimated like number of elders remaining as undiagnosed (ADA, 2002; Beckles, Engelgau, Narayan, Herman, Aubert, & Williamson, 1998; NIH, 1999). As the number of Americans over the age of 65 is expected to double
in the next decade, the prevalence of type 2 diabetes is also projected to double. Both the probability of contracting diabetes and the probability of developing complications associated with the disease increase with age. Difficulty with learning self-care management among elders with diabetes has been linked to increased risks of developing diabetes complications (Black & Scrogin, 1998; McDonald, Tilley, & Havstad, 1999; Stolk et al., 1995; Van Weerdt, Visser, & Van der Veen, 1998). This study was designed to examine factors that influence the ability of aging individuals to adequately perform diabetes self-care management. The factors considered in this study were age-related deficits, knowledge of diabetes as a chronic disease state, and health literacy.

This study was guided by Self-Care Deficit Theory (Orem, 1983, 1985, 1991). Orem’s Theory of Self-Care Deficit holds that self-care is a learned activity that is natural to adults. The main premise of the theory states that promotion of self-care contributes to the individual’s self-maintenance and promotes health-care well being (Orem 1983; 1985; 1991; 2001; 2003). Orem holds that the state of normalcy (the promotion of human functioning and development within social groups in accord with human potential, known limitations, and the innate desire to be normal) is founded on a set of common human factors. Basic conditioning factors (age, gender, health care systems availability, education, family systems elements, and patterns of living) and universal self-care requites (need for air, food, water, activity/rest, solitude/social interactions) influence an individual’s self-care practices.
Statement of Problem

Diabetes mellitus is a chronic disease of the endocrine system that involves either a complete deficiency of bodily produced insulin, or there is an overall decreased bodily ability to utilize insulin (CDC, 2000). Insulin is a hormone normally produced by the beta cells of the pancreas to facilitate cellular transport of glucose as well as being a vital component in the synthesis of protein and in the storage of fats. When the body is unable to produce or to fully utilize insulin, fats and excess glucose build up in the bloodstream. Over time this increased blood sugar content damages vital organs (heart, kidneys, eyes, etc.) and contributes to peripheral vascular problems. The causes of diabetes have yet to be determined but factors such as genetic links, environmental agents, obesity, and sedentary life-styles appear to be important (ADA, 2002).

Diabetes is the common overall term for a complex condition that comprises several categories. In 2002 the American Diabetes Association divided the traditional two categories that characterize diabetes as a medical condition into four distinct categories (ADA, 2002; Hispanics and Diabetes (National Institute of Digestive, Diabetes, & Kidney Diseases [NIDDK], 2002). Pre-diabetes, gestational diabetes, type 1-diabetes and type 2 diabetes are now recognized by the ADA as the four separate categories of this condition. Each category contains differing levels of severity, differing numbers of people presenting with that particular type of diabetes, and each category has its own unique set of self-management challenges. This discussion focuses only on type 2 diabetes as this is the most common form of the condition among elders.
Of those diagnosed with diabetes, 90-95% possess type 2, which has traditionally been diagnosed with advancing age. Treatment for type 2 diabetes may include an interconnecting set of dietary modifications, exercise regimens, combinations of multiple oral medications or adjustable doses of injectable or inhaled insulin. The regimen for treating diabetes mellitus is one of the most complex and demanding of all chronic conditions. Successful control of this condition is dependent on extensive patient education and active participation of patients in the plan of care (Duchin & Brown, 1996; Glasgow, Toobert, & Hampson, 1991; Gliden, Casia, Hendryx, & Singh, 1990; Jenny, 1983, 1984; Mangan, 1997). The person with diabetes must learn to balance the amounts and types of food; along with duration, intensity, and types of exercise; as well as symptom management, medication adjustments, and blood glucose monitoring (ADA, 2002). Numerous studies have demonstrated a positive correlation between glycemic control and the successful prevention of complications (Brown, 1988; Campbell, Redman, Moffitt, & Sanson-Fisher, 1996; Lipton, Losey, Giachello, Mendez, & Girotti, 1998; Sprague, Schultz, Branen, Lambeth, & Hillers, 1999; Stein, 1992; Wallerstein & Bernstein, 1998).

Complications of Diabetes

Diabetes mellitus is currently the sixth leading cause of death in the United States, approximately 200,000 Americans will die this year because of diabetes and diabetic complications (ADA, 2002). The major complications of diabetes are visual problems,
renal disease, neuropathy, and cardiovascular disease. Each of these increases costs to the health care system.

Diabetic retinopathy will blind between 12,000-14,000 individuals this year. This condition develops when elevated glucose levels damage the capillary beds of the retina leading to intraocular bleeding. The Centers for Disease Control (CDC) estimates that as many as 90% of these cases of blindness could be prevented with regular screenings and follow-up care for persons with diabetes (CDC, 2002). Approximately $470 million dollars of the federal health care budget might be saved if diabetic retinopathy could be prevented (CDC, 2002; Currie, Morgan, & Peters, 1998).

Each year more than 33,000 people develop renal complications from diabetes. The cost to Medicare for treating the more than 100,000 cases of renal failure related to diabetes averages $51,000 per person per year (CDC, 2002). This translates into a total expenditure of more than $5.1 billion dollars per year. Individuals in many minority ethnic groups suffer higher rates of kidney failure related to diabetes than their Anglo counterparts. Rates of early stage kidney disease related to diabetes are highest among these groups (NIDDK, 2002). Control of glucose levels and blood pressure is thought to be the key to reducing by half the total number of new cases of renal failure related to diabetes.

Diabetic neuropathy is the reduced sensation in the extremities related to decreased nerve cell transmissions that may lead to ulceration, gangrene, and, ultimately, amputation of the extremity. About 86,000 Americans undergo a diabetes related lower
extremity amputation each year (CDC, 2002). Current hospitalization costs for these amputations total more than $860 million dollars per year. The CDC (2002) estimates are that between 50-85% of these amputations are preventable if the individuals maintain lower glucose levels.

Persons with diabetes mellitus have a two-to-four times greater risk for the development of cardiovascular complications or of suffering a stroke than their glucose normal counterparts. Of the 200,000 deaths per year related to diabetes, approximately 65% are from heart disease or cerebral vascular accidents. Experts believe that by lowering blood pressure levels as well as controlling blood sugar and lipid levels that the number of deaths from diabetes could be reduced by 30% overall (CDC, 2002).

The implications for untreated diabetes at any age are clear with increased mortality rates from complications of atherosclerosis, coronary artery disease, and stroke. Research about the effects of diabetes on the mortality of the elderly by Croxson, Price, Burden, Jagger, and Burden (1994) and another by Bertoni, Krop, Anderson, and Brancati (2002) showed that the risk of premature death among elders with diabetes risk of premature death was 4.5 times higher than their normal glucose tolerant peers. The elderly are more susceptible to variation in glucose regulation than their younger counterparts with diabetes. The physical symptoms commonly associated with diabetes (polyphagia, polydipsia, and polyuria) may be absent in the elder with diabetes. Often it is not only the presence of hyperglycemia that leads to a diagnosis of type 2 diabetes in the elderly, but also the degenerative changes leading to the diabetic complications of
neuropathy and atherosclerosis. The health care practitioner and the elderly themselves may attribute classic diabetic symptomology, such as visual changes, nocturia, or lack of energy, to “normal aging” and dismiss or negate the severity of the presenting symptoms (Gallichan, 1997; Murphy & Kinmouth, 1995).

The trajectory for diabetes and its complications is a sharply downward slope if the glycemic indices are not brought into normal ranges (Beckles et al., 1998; NIH, 1999). Research done by the Diabetes Complications and Control Trial (Beckles et al., 1998; Gallichan, 1997; Mangan, 1997; NIH, 1999) as well other studies have demonstrated that complication rates can be reduced if glycemic control is maintained.

Almost $100 billion is expended each year for diabetes. This represents almost 6% of the nation’s total health care dollars; yet persons with diabetes represent a mere 4% of the total population (ADA, 2002; NIDDK, 2002; NIH, 1999). A large portion of these healthcare costs can be attributed to treating diabetic complications (Jonsson, 1998; Selby et al, 1997). In the U.S. today, the greater portion of the daily care for diabetes symptom management is done at home by the individual with diabetes (Clark, 1998). Through successful control, persons with diabetes potentially could decrease overall costs and their own rates of mortality and the morbidity related to the condition.

Factors Influencing Diabetes Self-Care Management

Several factors impact an individual’s ability to self-manage diabetes: exposure to diabetes education, aging, basic conditioning factors, and health literacy. Each of these factors is discussed in the following section.
Diabetes Education and Self-Care

The positive role of diabetes education in helping an individual to develop diabetes management skills has been recognized for over 20 years (ADA, 2002; Tildesley, Mair, Sharpe, & Cenzng, 1996; Young-Hyman, 1999; Watts, 1980). Structured educational sessions teach self-management as the means of achieving glycemic control. Most diabetes educational sessions in the U.S. today are compressed into one to three days of intensive training or training split into block sessions over several weeks. The content of these sessions includes dietary manipulation, self-blood glucose testing, medication regimes, symptom management related to hypoglycemia and hyperglycemia, exercise/activity routines, when to activate emergency medical systems, and disease prognosis. Less than 35% of all persons currently diagnosed with diabetes ever receive formalized diabetes education; yet these types of educational programs are now recognized as a standard of diabetes care (ADA, 2002; Coonrod, Betschart, & Harris, 1994).

While structured education is considered the standard of care, three factors limit its potential in reducing complications. First is the limited number of people who actually receive structured educational programs about diabetes. Factors that limit access to diabetes educational programs include not being formally referred by primary care providers, payment issues related to lack of health care insurance, classes conflicting with occupational or family care responsibilities, and lack of transportation.
Second, even if the services are provided, diabetes education may not be equally effective for all groups. Diabetes education may not be as effective for individuals in certain ethnic groups based on educational levels, primary language, and cultural patterns (ADA, 2002; Anderson 1991; Ooman, Owen, & Suggs, 1999; Tucker, Bermudez, & Castaneda, 2000; Zqibor & Simmons, 2002).

Third is the theoretical roots and structure of formal diabetes education. Contemporary diabetes programs focus on the acquisition of knowledge as opposed to the ability to apply information to self-care skills. Currently no diabetes educational program exists that targets the specialized learning needs of the elderly. Without a program that addresses their unique learning needs, elders with diabetes may fail to perform diabetes self-care techniques because of lack of knowledge. Current diabetes educational programs may have three major deficiencies that limit their potential for helping elders with self-care. First, the current format in which diabetes educational material is delivered may place some groups, such as elders, at a learning disadvantage, related to how the content is delivered. Second, there are few educational sessions directed at type 2 of diabetes, the most frequently occurring among those with the greatest rates of diabetes (e.g. elders, and certain ethnic minorities) (Ooman et al, 1999; Norris, Lau, Smith, Schmid, & Engelgau, 2002). Third, current diabetes educational programs do not permit for learner input into what they will study (Bruce, Davis, & Davis, 2000; Jayne & Rankin, 2001; Struck, Pathak, Burshell, Jayaraj, & Blonde, 2002; Watkins, Gillibrand,
Townson, & Gibbon, 2002). The self-selection of educational material to be learned is a hallmark of adult education theory.

For those persons who have been formally referred and experienced diabetes educational sessions, there is the possibility that some factors may be lacking in the current diabetes educational programs especially for those who are elderly. Many elders may need specially designed education programs that take into account the physiological alterations of aging (decreases in visual acuity, manual dexterity, and memory). This study was designed to better explicate the factors that impact on the capacity of elders to self-manage their diabetes.

Educational Models

Current diabetes educational programs are based on educational models that may not prove effective to all individuals. Existent theory links diabetes self-care with empowerment, self-concept, monitoring, and decision-making. Without a firm rational foundation of self-care management based knowledge of their condition, persons with diabetes may not integrate life style alterations to improve glycemic control into their daily life pattern on a long term basis.

What is missing in these theoretical models is explicit specification of the influences of age related factors (i.e. cognitive processing ability; visual acuity; and manual dexterity) to sustain self-care (Black & Scogin, 1998). These are additional areas that require further examination related to diabetes educational programs for elders. Evidence suggests that traditional group instruction of diabetes self-care material without
regard to the individual’s educational and/or cultural background is not effective in the reduction of complication rates for diabetes (Hjelm, Nyberg, Isacsson, & Apelqvist, 1999; Oomen et al, 1999). Work done by the Education Committee of the University of Michigan Diabetes Research and Training Center demonstrated that providing educational material alone to persons diagnosed with diabetes was insufficient in aiding them to adequately self-manage their disease (Van Weerdt et al, 1989). Studies done on conditions other than diabetes suggest that just increasing a patient’s knowledge about a treatment or a disease, without simultaneous adjustment of prior learned health behavior and level of empowerment, does not lead to compliance with treatment plans (Miller, 1993; Watts, 1980).

Studies directed at measuring the attitudes of health care professionals and patients related to diabetes have shown that the elders may not be seen as competent, either mentally or physically, for performing diabetes self care (Anderson, Fitzgerld, Gorenflo, & Oh, 1993; Lipton et al, 1998; Murphy & Kinmouth, 1995; Roberts & Krouse, 1990). When health professionals hold elders to a dependent position related to their self-care, the health professional contributes to the discrimination of elders by negating their right of active, informed participation in their own health care (Bommier & Stecklov, 2002). Traditionally, those with diabetes, and most especially elders with this condition, have been encouraged to maintain a passive stance in regard to the management of their disease processes. This passiveness in regard to self-care may stem from the negative social labeling of elders that occurs in Western society (Kuypers &
Bengston, 1973). Society at large and many health professionals have come to view the elderly as incapable of handling their daily health care. This passive and unquestioning attitude with a “disease illiterate” demeanor on the part of elders propagates the dependency of elders with diabetes within today’s health care system. Diabetes is a lifelong condition. The need for self-management of this condition does not decrease with age. The work of Holman and Lorig (1992) indicated that perceived self-efficacy to cope with consequences of chronic diseases could be enhanced by appropriate learning experiences. Of special relevance to self-management is the impact on health status of people’s beliefs about exercising some control over the conditions that affect their lives (Bandura, 1986, 1989, 1991, & 1997). Perpetuating the image of elders as “passive” recipients of diabetes education derails the positive effects of self-care management for their condition.

Restrictions on the number of diabetes educational sessions permitted through reimbursement by third-party payers (i.e. HMOs, insurance companies, etc.) may also place some groups, such as elders with diabetes, at a learning disadvantage. The standard practice in diabetes educational programs is to assess overall literacy levels with questions about the participants’ level of education. Literacy research has repeatedly demonstrated that the correlation between highest grade level achieved by an individual and literacy level is not necessarily strong (McGrail, 1984). Rarely is there a formalized method employed to assess the literacy level of a participant within a diabetes educational program based on the participant’s comprehension levels or length of time
needed to process information. The theories guiding diabetes educational programs may be part of the reason why current programs may be ineffective with elders. The following provides an overview why current educational approaches may not be effective.

Prior research has demonstrated that merely increasing a subject’s knowledge level of diabetes will not necessarily lead to a glycemic control (Beeney & Dunn, 1990; Bloomgarden et al, 1987; Gallichan, 1997; Funnell, Rosenthal, & Morely, 1992; Watts 1980). The vast majority of cases of Type 2 diabetes occur in persons over age 65, yet the educational process for self-care and diabetes information on the whole is framed along mainly pedagogical educational formats. Few allowances are made for the physical, cognitive, and social differences of the elderly within diabetes educational programs. The low priority given to patient education among elders, their support systems, and the healthcare community is yet another factor that negatively impacts learning diabetes self-care management in the elderly. The majority of the research completed on outcomes of diabetes educational programs has focused on the increase in diabetes knowledge by the participants. Little research has been conducted on the effective application or long-term retention of diabetes knowledge among participants of any age level. Without the measurement of the patient's ability to apply diabetes information into their diabetic treatment regiments, it is not possible to assess the importance of the factors that have been previously identified as impacting self-care.
Summary of Educational Models

Although there is an increasing recognition of the importance of diabetes patient education as a major component in diabetic management, delivery of that information, for elders in particular, is often inadequate by current ADA recommended standards of practice (ADA, 2000). There is a paucity of diabetes educational programs structured around the learning-related needs of older Americans. Price (1993) demonstrated the lack of actual ability among persons with diabetes to apply diabetes knowledge into a diabetes regimen.

The need for diabetes educational programs developed for use by elders with diabetes can be demonstrated by two points. First, a literature search of OVID, MEDLINE, CINAHL, and PsychINFO to date failed to produce any empirical studies linking any specific learning theory underpinning a diabetes educational program and the self-care application outcomes for individual learners of that program. Second, all of the learning theories currently employed (self-efficacy model, health belief model, and adult learning theory) have limitations as to their applicability in an effective adult diabetes educational program for elders based on their foundations in pedagogical methodology, assumptions of subject acknowledgement of the severity of their disease, and beliefs in the subject’s ability to impact outcomes of the condition through behavior modification.

Aging and Diabetes

The process of aging has the potential to influence how people learn self-care information related to diabetes. Aging may be viewed as being composed of three
structural units: biological, mental/psychological, and social (Markides & Mindel, 1987). Each of these units evidences alterations along a continuum over time.

Biological aging process is evidenced by changes in the individual’s physical appearance. While it does appear that a generalized Gompertz mortality curve is a universal, it may not be applied to all persons at the same instant in their lives. Work based on Prigogine’s studies (1978) suggested that physical aging may be explained by a dynamic systems theory, whereby periodic internal and external fluctuations, or series of fluctuations increase to an overwhelming critical point that shatters the preexisting structural form. This shattering of prior form then creates new order from disorder which may be viewed as either growth or decline. Birren and Schroots (1996) defined aging as both a negentropic (anabolic) and entropic (catabolic) process. Over a lifetime of transformations into higher and lower order behaviors, an individual progressively tends toward more disorderly than orderly behaviors. The capacity to learn continues until death; however, other factors associated with aging have the potential to affect the learning process (e.g. physical alterations, memory changes, and social factors).

Physical Alterations and Aging

With advancing age, physical changes occur at varying rates making older adults the most heterogeneous of the chronological cohorts. The work of Baltes and Baltes (1992; 1998) describes the physiologic changes of aging as progressive, universal, and decremental. The limitations imposed by these alterations may vary greatly based on multiple factors. However, the decreasing acuity of the physical senses (sight, sound,
touch, taste, and smell) may influence the older individuals’ ability to learn and the speed with which they learn.

For example, hearing acuity for high-pitched tones generally begins decreasing in the fourth or fifth decade of life. This decrease may prevent older individuals from accurately hearing information related to diabetes self-care management that is delivered in lecture format. Color distortions related to the yellowing of the optic lens and the onset of presbyopia prevent many older adults from reading fine print, except in the presence of a strong light source. Lighting features in many clinical settings (by far the most common physical location for diabetes teaching sessions) are usually limited to overhead, fluorescent systems, increasing the chances for glare when reading. Manual dexterity may decrease as chances of osteoarthritis increase with age. The inability to manipulate objects like self-monitoring blood glucose equipment may impact on an elder's ability to perform self-care.

Mental/Psychological and Aging

The psychological markers of the aging process may be documented by alterations in learning, memory, and motivation. Component subunits of human memory include sensory (information received by sensory receptors and held briefly prior to registration in awareness), short-term (also called primary memory is a limited-capacity for very specific information storage), and long-term (area of unlimited storage capacity
that is capable of holding information for longer periods of time) (Nilsson, L, 2003; Backman, Small, & Wahlin, 2001; Anderson, Reder, & Simon, 1997; Kausler, 1994; Ormrod, 1995). The millisecond storage capacity of sensory memory is impacted by the physiological declines of the elder’s sense organs. Short-term, or working memory, has an estimated storage capacity of 5-30 seconds (Kausler, 1994). The slowing of neurological processes in elders directly impacts how much information may be housed in the short-term memory and for how long. Implicit and declarative memory (long-term) remains intact for most elders, but the processing and storage of newly coded information takes longer. The slowing of nerve impulse conduction rates with age may have a direct impact on reflex action and information processing time (Fried, Ettinger, Lind, Newman, & Gardin, 1994). Elders need longer periods of time to process information related to slowing of nerve conduction; however, current diabetes educational programs are structured on a strict time limit related to third party payer requirements. These restricted timed educational sessions may limit an elder’s ability to process diabetes self-care management information. In addition the neurological implications of uncontrolled diabetes on the peripheral nervous system are an established medical fact; however, few empirical studies have looked at the implications of diabetes on the microcirculation and potential neuropathy of brain tissues among elderly persons.

The alterations in cognitive ability related to aging are seen in the lowered amounts of fluid intelligence (ability to perform abstract thinking) and the increased
presence of crystallized intelligence (experiences and information learned over a lifetime). The prior viewpoint that the decline in fluid intelligence resulted in specific changes to the elder’s cognitive ability (Horn & Donaldson, 1980) has been supplanted by the notion that overall decreases in biological function related to aging equate to a decrease in fluid intelligence (Baltes & Lindenberger, 1997; Salthouse, Handcock, Meinze, & Hambrick, 1996). The time required to process and react to information increases. However, if the time requirement in intelligence tests is eliminated, elders do as well on such examinations as younger adults.

Social Aging

Social Learning Theory is based on the notion that people exist within a social setting and that it is within this social setting that all learning, including health education about chronic disease conditions, occurs. Age is a social fact that means more than having lived a certain number of years. All cultures have some criterion measures for aging. The phases of the human life cycle are embedded within the societal contexts of cultures. It is the social significance attached to the various periods of the life cycle that determines the value of the individual within culturally prescribed roles (Henry, Arrow, & Carino, 1999; Homes & Homes, 1995; Ward, 1984). The role the elder within current in the U.S. society is perhaps the least ritualized stage of the various points on the human developmental trajectory and therefore the least valued.

Since each culture creates its own perceptual lens by which it defines reality for its members, the value of each member, and the role that the member plays, is set within
this overriding framework. The U.S. culture has glorified youthfulness, health, and economic productivity. Elders in this society, especially those with a chronic condition, have experienced the resulting prejudicial impact of this culture of youth perspective. The majority of the resources for diabetes research and educational programs have been aimed at the type 1 population, even though the number of those with type 2 vastly outweighs this group by a ratio of more than 15:1. The greatest rates of complications and health care expenditures from diabetes occur among the aged. It is the rate of increased diabetes complications, coupled to the lack of direct involvement of elders in their own diabetes health care, which dictates the need to assess the factors that impact diabetes self-care in older age groups.

Health Literacy and Diabetes

There is very little reported information concerning the participation of older adults in diabetes education and care programs or of the effectiveness of education with elders. The National Institutes of Health (NIH) has mandated the increased inclusion of elders, along with all other age groups, within intervention research. However, despite the NIH guidelines, few empirical studies have as yet explored the relationships among aging, self-care, and health educational program effectiveness. Traditionally, elders have been excluded in empirical research studies because of this age group’s high rate of co-morbid conditions (Rimmer, Keintz, Glassman & Kinman, 1986). This lack of involvement of elders in research areas impacting them lessens the probability that the results of these studies can be generalized to this population. Work done by Sprague et al
(1999) cited the decreased priority given to patient education among elders, their support systems, and the healthcare community as yet another factor that negatively impacts their learning diabetes self-care management. This trend suggests that elders are not being targeted in health education programs for chronic conditions, and/or that the current educational programs are not adequately serving the needs of the elderly. How well elders are able to learn self-care management techniques related to diabetes is not documented in the literature. With the increasing numbers of elderly with type 2 diabetes, it is in the best interests of those with the condition, health care professionals, and funding agencies to determine which factors impact diabetes self-care as a precursor to the development of more effective diabetes self-care interventions.

An individual’s level of health literacy, exposure to diabetes educational sessions, and knowledge of diabetes as a chronic condition may be impacted by basic conditions factors such as socioeconomic level or ethnicity. The ability to perform self-care management is influenced by basic condition factors. Health literacy is an individual basic conditioning factor. Health literacy (the ability to apply health information into personal health care) is a concept ignored in most education programs for diabetic self care. Literacy is defined by the National Literacy Act (NLA) of 1991 as an individual’s ability to read, write and speak English and to solve problems at a level of proficiency sufficient for the individual to achieve goals on the job and within the society (JAMA, 1999; Tones, 2002). The National Adult Literacy Survey (Kirsch, Jungeblut, Jenkins, & Kolstad, 1993) found that some 40 million Americans are functionally illiterate, while an
additional 40 million possess only marginal literacy skills. This translates to the alarming fact that half of the adults in this country have significant deficiencies in reading and computational skills. Fully half of the nation’s elders scored among the lowest levels for reading and reading comprehension on the national adult literacy survey (Parikh, Parker, Nurss, Baker, & Williams, 1996; Thompson, 2001). While the low level of literacy in America is an acknowledged fact, relatively little research has focused on how the level of literacy impacts patients with chronic health conditions. An electronic search of various on-line databases (OVID, CINAHL, MEDLINE, & PsychINFO) demonstrated no research studies on the relationship between health literacy and diabetes self-care management in elders. The findings of the national adult literacy survey should raise serious concerns among health care professionals with regard to the ability of many Americans to function adequately within today’s health care system.

A person’s ability to read and comprehend written directions and to correctly perform numerical tasks related to treatment plans from health care providers is defined as functional health literacy (JAMA Council on Scientific Affairs, 1999). Various studies have demonstrated that inadequate health literacy may be a significant factor in patients' lack of understanding of their medical diagnosis, treatment options, and overall quality of care (Baker, Gazmararian, Sudano, & Patterson, 2000; Max, 1996; Williams et al, 1995; Wright, 1996).

Many of today’s elders, while in their youth, lacked the educational opportunities available to young people today. As a result of this decreased lack of educational
preparation, one-third or more of today’s elderly have experienced 8 or less years of formalized education. The documented rate of literacy among many of those over age 65 is low (Jackson, Davis, Murphy, Bairnsfather, & George, 1994). Most health information (i.e., prescription labels consent forms, appointment schedules, or health information brochures) is written at an educational grade level exceeding the reading and comprehension levels of many of the elders with decreased literacy levels (Wilson, Racine, Tekieli, & Williams, 2003; Wright, 1996). This may place many of today’s elders at an additional risk for medical complications based on a potential inability to read and follow written medical directions. While researchers have examined the relationships of health literacy in some populations, the tendency with these studies is to group the elderly within an overarching study population. Of the two major studies completed on health literacy among elders specifically the results have confirmed that decreased health literacy has an adverse impact on the individual’s state of health (Gazmararian, Williams, Peel, & Baker, 2003; Baker, Gazmararian, Sudano, & Patterson, 2000). Elders with diabetes and low literacy levels, functioning within the present self-care management framework, may be more at risk for adverse events because of the complex nature of diabetes management.

Differences in the health literacy levels of various ethnic groups and the impact of primary language have not been extensively researched for their impact on self care among elders with diabetes. Work done by Guthrie, Schafer, & Hutchinson (1992) and Adams-Price (1993) on the correlation between prior exposure to written material and
test scores based on that material again demonstrates that those from certain ethnic backgrounds have reduced health literacy. The level of ethnic identification and assimilation into the dominant culture may impact the elder’s ability to learn (Adams-Price, 1993). Hence elders whose first language is not English (such as some Hispanic elders) may be less able to read and interpret health educational material that has been developed for the dominant culture.

Diabetes is one of the most medically complex of the chronic conditions to manage. Yet the trend in health care today is for each person with diabetes to assume most of the self-care management of this condition within the home environment. The intricate regime for diabetes self-care management is based on the individual being able to correctly read, assimilate, and problem solve the multitude of diabetes educational materials including the pathophysiology, medication dosage adjustments, symptomology treatment and risks, dietary substitutions, and exercise physiology. Studies on other conditions have demonstrated a correlation between low health literacy levels and increased complication rates (Thompson, 2001; Tones, 2002.). Persons with diabetes and low literacy levels, the elderly or those from traditionally medically underserved ethnic backgrounds, may be at greater risk for the development of diabetic complications based on their lower health literacy levels. This study explored the potential links between health literacy and diabetes self-care management among elders with diabetes.
Basic Conditioning Factors and Self-Care

Basic conditioning factors, defined as personal characteristics, also influence self-care abilities. Orem defines basic conditioning factors as age, gender, developmental state, sociocultural background, state of health, family systems factors, health system factors, environmental factors, as well as resource availability and adequacy (Orem, 2003; 2001). Not all of these basic conditioning factors were explored in this study. Studies of diabetes self-care may report demographic information as a part of the information gathered, but often do not address either gender or marital status as study variables. However a few studies have explored the impact of demographic information on diabetes self-care management. For example, work done by Polonsky, Anderson, Lohrer, Aponte, Jacobson, and Cole (1994) as well as Al-Windi, Elmfeldt, and Svardsudd (2000) documents a difference in how the genders elicit and utilize health care with women being more likely to access the health care system than men. The majority of people over the age of 65 are female; therefore there are more females with type 2 diabetes likely to utilize the health care system now and in the future. The importance of social support systems (married versus single lifestyle) for those dealing with chronic conditions was examined by Trief, Himes, Orendorff, and Weinstock (2001) and Hubbard, Muhlenkamp, and Brown (1984) with married persons exhibiting a more reliable social support system than unmarried persons. Most women over the age of 65 are widowed with adult children as their social support system. Basic conditioning factors may have an impact on the personal factor of health literacy as it relates to diabetes as a
chronic condition. The importance of the social setting in which the elder with diabetes exists needs to be studied in greater detail to ascertain the impact of basic conditioning factors on diabetes self-care management.

Factors Impacting Self-Care Summary

Several factors potentially impact self-care among elders with diabetes. Their overall level of physical changes related to aging (cognitive, visual, and manual dexterity impairment) may affect the elder’s ability to problem solve, gather diabetes related information, or manipulate the objects necessary to perform self-care management. The basic conditioning factors (age, gender, developmental state, sociocultural background, state of health, family systems factors, health system factors, environmental factors, as well as resource availability and adequacy) may impact the individual’s ability to perform self-care by potentially limiting the elder’s ability to obtain self-care supplies and information. Prior exposure to diabetes education and knowledge of diabetes as a condition may impact the elder’s level of understanding of this disease, its trajectory, and recommended self-care management. Health literacy may limit the elder’s ability to understand and problem solve the many treatment regime issues that arise daily for those performing diabetes self-care management. This study examined the factors that may impact an elder's ability to perform diabetes self-care.

Theoretical Background

Orem’s concept of self-care was the theoretical framework guiding this study. The Self-Care Deficit Theory (SCDTN) constitutes a general theory of nursing with three
constituent theories comprising it (Theory of Self-Care/Dependent Care, Theory of Self-Care Deficit, and Theory of Nursing Systems) (Orem, 1985; 1987; 1991; 2001; 2003). A common set of assumptions regarding human characteristics subsists within each of these theories:

- People perform actions deliberately in response to internal and external stimuli.
- These deliberate actions are necessary to assure continued life and well-being.
- A person’s ability to respond to internal and external stimuli constitutes agency.
- The ability to act is a learned behavior that varies with development/maturational levels.
- Abilities when exercised produce actions that seek to satisfy a goal.
- Action is an expression of the exercise of an individual’s agency.
- Physical and intellectual developments are necessary to meet stimuli over time.
- Employment of self-abilities constituting agency focuses on discovering, developing, and transitioning to the self, ways of acting deliberately to identify and meet requisites.
- Persons live, grow, and mature within social groups. Memberships within these groups structure roles and tasks for individual members.
At the core of SCDTN, the Theory of Self-Care explains how and why persons care for themselves. The Theory of Self-Care Deficit seeks to provide parameters for when people have need for nursing services. The Theory of Nursing Systems describes what nursing is and the nature of the profession.

Theory of Self-Care

Orem defines self care as “learned behavior composed of deliberate goals that direct actions” that are perquisites by “knowing” and “deciding” (Orem 1991). In this theory people are viewed as continuously engaging in self-care actions in the process of daily living to meet Orem’s three types of requisites (universal, developmental, and health deviations). Social interactions and experience allow individuals, as they mature, to gain deliberate actions and abilities to meet their self-care needs. Use of formal information systems supplements experimental knowledge in determining which requisites should be meet and how. The overall goal of self-care is the self-monitoring and promotion of the individual’s health and well-being. The basic conditioning factors (age, gender, developmental state, sociocultural background, state of health, family systems factors, health system factors, environmental factors, as well as resource availability and adequacy) as well as the three levels of requisites impact an individual's ability to perform self-care. Orem views technologies as the knowledge, intellectual, and psychomotor abilities essential to successfully completing a deliberate action.

Self-care occurs when the individual takes a deliberate action to meet known self-care requisites. The abilities to perform self-care are gained through the social process of observation, investigation, and practice. All learning occurs within a social context. All
persons have the potential for learning and developing abilities to care for the self based on their developmental levels.

Theory of Self-Care Deficit

The central tenet to The Self-Care Deficit Theory (Orem, 2001) is that persons are subject to change in structural, functional, and developmental levels over time. Therefore, the level of self-care that the individual can perform adjusts over time to meet these alterations in functional status. Foundational to this theory are several major elements:

- Individuals are members of social groups
- Self care is a learned activity that happens within social groups
- Basic conditioning factors in any society designate which of its members may accept, or require, dependent self-care and when this will occur
- Health care services are socially structured to aid members when their abilities to perform self-care is compromised
- Nursing is one health service within societies.

This theory focuses on the relationship between the individual’s ability to perform self-care and the totality of self-care requisites placed on that individual at any point. A self-care deficit occurs when the demand for self-care (need) exceeds the individual’s self-care agency (abilities). Persons with a self-care deficit are of concern to nurses because those individuals may not be able to meet their own self-care requirements.
Self-care deficits may arise from a variety of sources, can be of a temporary or permanent nature, and may be eliminated or reduced in scope by nursing actions. The exact nature of the relationship between self-care demand and self-care agency can be determined only after both the nature of the demand and degree of self-care agency are assessed. The expressions of self-care deficits are made in terms of statements of action limitations associated with projections of deliberate operations to correct them. It is this process of self-care deficits (either projected or existing) that establishes a socially sanctioned dependency that legitimizes the need for nursing care.

Theory of Nursing Systems

Orem’s theories of Self-Care and Self-Care Deficit are pivotal to the Theory of Nursing Systems. Persons perform deliberate actions that are directed to their own care needs thereby producing actions termed as self-care, however, in some situations the needs of the individual will exceed that person’s abilities to care for themselves. Nursing, then, is the institutional vehicle by which care is administered to the person with a self-care deficit. By engaging in nursing agency (e.g. acquired knowledge and abilities for nursing practice), nurses identify those with self-care deficits and contract to provide appropriate help through nursing actions within a set time period. Nurses, by virtue of their specialized knowledge of diabetes as a chronic condition and the self-care management issues faced by those with diabetes, are able to supply or augment the individual’s diabetes self-care management.
Links Between Orem’s Theories and Model Tested in this Research

Elders, by Orem’s definition, perform self-care as a part of daily living. They have learned these deliberate self-care management actions through social interactions with the goal of continuing their well being. Utilizing their own abilities to perform self-care is dependent on their abilities to identify and meet self-care needs.

According to Orem’s Self-Care Deficit Theory, elders with diabetes may evidence self-care deficits due to either developmental or social factors. Age related developmental deficits (personal factors), such as altered cognition, decreased manual dexterity, and decreased vision, may impact diabetes self-care management by impeding the elders’ ability to meet the self-care needs of their condition by limiting how self-care information and materials are utilized. Social factors (basic conditioning factors over which the individual has no direct control), the personal factors (areas under direct control of individual) of disease (diabetes) specific knowledge, health literacy, and exposure to diabetes education impact the ability of elders with diabetes to perform diabetes self-care. Lack of self-care ability reduces the elders’ overall ability to perform diabetes self-care.

Theoretical Model

The model below posits that three main factors may influence an elder’s ability to engage in diabetes self-care. Developmental deficits (the physical and mental changes in an individual’s abilities that occur with advancing age) include the age related deficits of altered cognition, decreased visual accuracy, and decreased manual dexterity directly influencing diabetes self-care. The personal factor of health literacy may itself be impacted by basic conditioning factors, while also influencing an elder’s diabetes specific
knowledge and impacting directly diabetes self-care management. Exposure to diabetes education and basic conditioning factors may influence self-care by elders with diabetes by impacting knowledge of diabetes and health literacy.

Figure 1. Theoretical Model of Factors Impacting Diabetes Self-Care in Elders

Stage 1          Stage 2          Stage 3

Developmental Age Related Deficits

- Age Related Deficits
  - Cognition
    - Everyday Cognition
    - Battery Questionnaire
  - Visual acuity
    - Snellen Near Vision Test
  - Manual dexterity
    - Jebsen-Taylor Hand Function
  - Diabetes Self-Care in Elders
    - HbA1c level

Social Factor

- Basic Conditioning Factors
- Demographics

Personal Factor

- Health Literacy
  - STOFHLA
- Disease Specific Knowledge
  - MDRTC Brief Diabetes Knowledge Test

Personal Factor

- Exposure to Structured Diabetes Education Information obtain in Demographic Section
Explanation of Theoretical Model

According to the proposed model there are three factors that may directly impact an elder’s ability to perform diabetes self-care: age related deficits occurring due to physiological changes, disease specific knowledge, and health literacy. Age related deficits associated with cognition, visual acuity, and manual dexterity may impede an elder’s ability to perform diabetes self-care. A basic understanding of diabetes specific knowledge and how to perform daily self-care management is requisite for elder independence in self-care. The level of health literacy possessed by the elder may also directly impact the elder’s ability to perform diabetes self-care by limiting the information comprehended during diabetes educational sessions. Basic conditioning factors as well as prior exposure to a structured diabetes educational program may impact the overall health literacy of the elder with diabetes by limiting access or ability to process health related information. Disease specific knowledge also serves as a mediator between health literacy and diabetes self-care in elders.

Diabetes self-care requires that the elder possess adequate function of three main physiological factors: cognitive function (ability to problem solve and remember self-care activities), sight (visual acuity sufficient to allow individual to read medication and nutritional and informational material related to diabetes), and manual dexterity (adequate hand coordination and strength to perform self-care manipulation of items).

Cognition may be described as the individual’s ability to register, store, and use information (Anderson et al, 1997). For an elder to engage in diabetes self care the level of individual cognitive functioning must be sufficient in the areas of attention span,
language competence, memory, and conceptualization. A global measure of cognition in diabetes self-care would need to be concerned with the elder’s ability to interpret self-care data such as current blood sugar level and then allow for a reasoned judgment on the most beneficial actions based on that reading.

Decreasing visual acuity is a hallmark of the physiological changes of aging that might impact on the elder’s ability to process educational material about his/her own condition (Bernbaum, Wittry, Stich, Brusca, & Albert, 2000). Without adequate eyesight the person with diabetes is unable to successfully perform some of the self-care tasks such as reading nutritional labels on food packages or drawing up insulin in a syringe.

Manual dexterity is necessary for the person with diabetes to manipulate by fine motor movements blood glucose monitoring equipment, to prepare food, and administer medications. Arthritis, present in 1/3 of all U.S. adults, may limit the physical dexterity needed to perform many of the self-care techniques (American Association of Retired Persons, 2000). Each of these three physiological factors may have a direct impact on the elder’s ability to perform diabetes self-care techniques, but not necessarily on their ability to acquire diabetes self-care knowledge. Most research completed to date on diabetes specific knowledge has focused on the individual’s ability to increase their own individual informational content but few studies have examined the individual’s ability to adapt and utilize the increased information in everyday life (Beeney, & Dunn, 1990; Bloomgarden et al, 1987; Price, 1993).
Central to diabetes self-care is disease specific knowledge. Diabetes specific knowledge is the level and amount of information that the individual possesses in regard to the diabetic condition and disease trajectory. There are several factors which might influence the acquisition of knowledge. If the ultimate goal of a diabetes educational program is to prepare individuals to impact their condition through self-care techniques, then there may be several predisposing factors, which have a direct impact on the effectiveness of such educational program outcomes. Elders, by virtue of the physiological changes related to the aging process, may experience a decrease in their overall levels of cognition creating an additional learning barrier to diabetes self-care that may need to be overcome.

Another factor, which may directly impact the elders' ability to perform self-care, is their overall health literacy level. With approximately 50% of all U.S. adults functioning at a literacy rate judged as being only marginal, the elder’s ability to process and implement the self-care information provided during diabetes educational sessions may be inadequate (Kirsch, Jungeblut, Jenkins, & Kolstead, 1993). Health literacy may also impact disease specific knowledge, a variable that may mediate diabetes self-care. If the individual has little understanding of the prognosis of the condition, potential complications, or the impact of self-care on that disease trajectory, the likelihood of sustaining self-care to improve glycemic control is doubtful.

Basic conditioning factors such as age, gender, developmental state, sociocultural background, state of health, family systems factors, health system factors, environmental factors, as well as resource availability and adequacy impact the individual’s ability to
perform self-care indirectly. Assessment of these components of the individual with diabetes allows for placement within the prevailing social, economic, and development norms for his/her condition. Information concerning the conditions under which the individual lives permits both the individual and the nurse to gauge the level of self-care agency that exists (Orem, 1983, 1987, 1991).

Exposure to a structured diabetes educational program also impacts the ability of the individual to perform diabetes self-care management by increasing probable exposure to diabetes self-care information. Adult learning theory holds that adults must be exposed to information in multiple settings prior to integration of the material. Learning may occur within three basic settings: formal instructional programs, non-formal sessions, and informal self-directed contexts (Merriam & Caffarella, 1999, p. 26). Patient education related to some diabetes self-management (diet, self-blood glucose monitoring, exercise) has been documented as being at least temporarily effective in some populations (Brown, 1990; Brechner, Cowie, Howie, Herman, Will, & Harris, 1993; Padgett, Mumford, Hynes, & Carter, 1988). No research currently exists that explores the type of diabetes educational program attended by the individual to long-term glycemic control among elders with diabetes.

Overview of this Study of Factors Impacting Self-Care in Elders with Diabetes

The following sections deal with those factors that impact the ability of elders with diabetes to successfully perform self-care within the parameters of this study.
Operational definitions are given along with the purpose of this study, research questions to be answered, and the significance of the study to healthcare.

Operational Definitions

1) Type 2 diabetes (non-insulin dependent diabetes) was defined as a chronic metabolic condition in which the body either produces insufficient amounts of insulin or the insulin hormone that is produced is chemically incapable of facilitating cellular transport of glucose molecules. The study entrance criterion was self-identification as a person with type 2 diabetes.

2) Diabetes self-care was defined as a complex interplay of a variety of activities performed by the individual with diabetes in the daily management of this chronic condition. The goal of diabetes self-care management is to permit individuals with diabetes to have an overall pattern of normal glycemia that will delay or prevent diabetes complications and allow them to live their lives to their fullest potential. The factors that require daily monitoring and adjustment in the self-care regimen include:

- dietary adjustments (types and amounts of food consumed)
- physical activity (types and duration accomplished)
- symptom recognition and management (signs of hypoglycemia, hyperglycemia, when to alert medical personnel of alteration in symptoms)
- self-monitoring of blood glucose levels (range and frequency, potential pattern of fluctuations)
- medication routines
- foot and oral care (monitoring for signs of infection or injury).
3) Diabetes self-care was measured in this study by the individual’s glycated hemoglobin (HbA1c) levels as an indicator of glycemic control.

4) Elder was defined as anyone over the chronological age of 62 in compliance with national social security standards.

5) Age Related Deficits was defined as those physiological conditions that tend to decrease in acuity or functionality as the individual advances in chronological age. The age related deficits in the study were visual acuity, cognitive processes, and manual dexterity.

- Cognition was defined as those mental processes involving problem solving and memory that permit the individual to make rational choices between alternative options.

- Visual acuity was defined as the level of sight needed to read commonly available printed materials.

- Manual dexterity was defined as the ability to manipulate objects in a timely manner necessary for diabetes self-care.

5) Health Literacy was defined as the subject’s ability to read and comprehend written health care information and to correctly perform numerical tasks related to their own individual health care.

6) Exposure to Structured Diabetes Education was defined as having attended educational sessions taught by either a physician, RN, dietitian or certified diabetes educator, in either an intensive or extended format.
7) Diabetes Disease Specific Knowledge was defined as the ability to correctly identify information related to diabetes as a chronic condition and information on diabetes self-care as evidenced by a high score on the MDRTC.

8) Basic Conditioning factors were defined as the self-identified demographic information supplied by the subject. They are indexed in this study by data on age, gender, martial status, first language learned, and years of formal education.

Purpose of Study

The purpose of this study was to test a theoretical model (Figure 1) that posited relationships among age related deficits (cognitive problems, vision acuity, manual dexterity), basic conditioning factors, health literacy, disease specific knowledge, exposure to diabetes education, and diabetes self-care in elders. This model hypothesized the impact of five factors (age-related deficits; health literacy on disease/diabetes specific knowledge; health literacy and exposure to structured diabetic education on the acquisition of disease specific knowledge; exposure to structured diabetes education and basic conditioning factors on health literacy) on the ability of elders to successfully perform diabetes self-care management.

Research Questions:

1) What is the impact of age-related deficits on diabetes self-care among elders with type 2 diabetes?

2) What is the impact of basic conditioning factors on health literacy among elders with type 2 diabetes?
3) What is the impact of exposure to structured diabetes education on health literacy among elders with type 2 diabetes?

4) What is the impact of exposure to structured diabetes education on disease specific knowledge among elders with type 2 diabetes?

5) What is the impact of health literacy on diabetes self-care among elders with type 2 diabetes?

6) What is the impact of health literacy on disease/diabetes specific knowledge among elders with type 2 diabetes?

7) What is the impact of diabetes specific knowledge on diabetes self-care among elders with type 2 diabetes?

Model Hypotheses:

1) Model Hypothesis #1: Age Related Deficits, Health Literacy, and Diabetes Specific Knowledge Impact Diabetes Self Care.

2) Model Hypothesis #2: Basic Condition Factors and Attendance at Diabetes Educational Classes Impacts Health Literacy.

3) Model Hypothesis #3: Attendance at Diabetes Educational Classes Impacts Diabetes Disease Specific Knowledge.

Significance of the Study to Health Care and Nursing:

Diabetes is responsible for many hospital admissions as either a primary or secondary diagnosis (Wagner, Sandhu, Newton, McCulloch, Ramsey, & Grothaus, 2001; Klonoff & Schwartz, 2000; O’Brien, Shomphe, Kavanagh, Raggio, & Caro, 1998). The
need to identify factors related to enhancing self-care management and reducing rates of complications among persons with diabetes is acknowledged (Brynes, Lee, Brighton, Leeds, Dornhorst, & Frost, 2003; Gaston & Vinicor, 2001; Garcia & Suarez, 1996). Education, a key nursing role, is the cornerstone of diabetes self-care. However, little theory exists to guide the educator in knowing how best to assist elders to learn diabetes self-care. Without a sound theoretical basis for practice it is uncertain if the current system of diabetes education is truly the most effective for elders. Two areas of neglect (attention to individual health literacy and attention to age related deficits) on the part of the health providers may be key to enhancing the long-term efficacy of diabetes educational programs. With a population that is aging, nursing will continue to face great challenges due to the increase of Type 2 diabetes cases in the next 20 years creating an ever increasing demand for strong educational programs.

Summary Chapter 1

Current levels of understanding related to how a person with chronic illness learns self-care information are incomplete. A greater understanding of the process will permit the development of more potentially successful nursing educational interventions.

The need for concentrating diabetes self-care research on educational programs for elders with type 2 diabetes can be attributed to several converging factors. First, elders with their increased risk of developing type 2 diabetes as they age, are an ever increasing portion of the U.S. population overall. Second, the rise in the number of elders from minority groups with a high diabetes prevalence rate and historically low access to
health care information, such as Hispanics - now the fastest growing minority in the U.S., adds to the increasing number of persons with type 2 diabetes with limited health literacy within the senior population. This increases the probability of ever-greater numbers of person with type 2 diabetes occurring and also the need for culturally relevant educational programs. Those few educational programs that have been developed for persons with type 2 diabetes tend to focus on lifestyle alterations without regard for learning diabetes self-care information. Third, the amount of empirical research into type 2 diabetes and self-care management lags greatly behind the amount of research undertaken for type 1 diabetes. Less than 10% of those diagnosed with diabetes are classified as having type 1 based on a literature search of OVID, MEDLINE, CINAHL, and PsychINFO. This means that 90% of those with diabetes have type 2. This raises questions on the validity of generalizing these studies to type 2 populations that are older and have an entirely different form of the disease. The differences in the overall development, symptomology, treatment, and types of complications of the two major forms of diabetes makes generalization of study results based on type 1 diabetes research questionable to type 2 populations. The additional factors of age and variations in health literacy must be taken into account before effective interventions for type 2 diabetes self-care management can be developed.
CHAPTER TWO
LITERATURE REVIEW

The literature reviewed for this work has been assembled from studies on: 1) self-care in chronic illness and self-care in diabetes; 2) studies on basic conditioning factors as well as factors impacting self-care in diabetes; 3) the impact of development deficits on diabetes self-care; 4) how knowledge and diabetes education impacts glycemic control and self-care; and 5) research on health literacy. Few studies exist that have examined how aging influences self-care among persons with diabetes.

If individuals are to be responsible for the majority of daily care for chronic conditions, self-care and techniques to support that care should be in the forefront of health related educational programs. The self-care movement has become a corner stone of disease prevention and management of chronic conditions. Self-care as a concept in relation to health has been defined as the individual’s deliberate actions aimed at maintaining or improving the individual’s health status. Orem's Theory of Self-Care deficit posits that self-care is composed of those personal activities that individuals require each day to regulate their functioning and development (Lemmerts, Teel & Pendleton, 2002).

Self-care in diabetes has been defined as the individual’s self-identified management abilities (ADA, 2002). These self-care management abilities include the capability to use diabetes knowledge to balance physical, emotional, and activity levels and manage medications and nutritional intake to achieve optimal glycemic control (ADA, 2003). Most diabetes self-care research to date has viewed self-care from the lay
(what individuals can do for themselves) versus a health professional perspective. This assumes that self-care by elders is essential to their sense of control; however, little empirical justification exists for this. A second problem with self-care research in elders is that while a number of studies investigate self-care characteristics and factors that influence self-care, little research has focused on self-care as an outcome. It then appears that a core component (the correlation between self-care and well-being) to the self-care concept, at least for elders with diabetes, has not been examined through empirical research.

Self-Care in Chronic Conditions

Research shows that self-care education improves health outcomes for those with chronic conditions. For example, Lorig and colleagues (2001) completed a two year study of the impact of self-care education on chronic disease management by 832 individuals with a variety of conditions (heart disease, lung disease, stroke, or arthritis) living in the community. Over the two years of the study, participants enrolled in the educational intervention demonstrated reduced utilization of emergency and out-patient visits, while reporting an increase in their sense of self-efficacy. This study demonstrates that self-care management programs are capable of improving some aspects of health among those with chronic conditions.

Lorig, Gonzalez, and Ritter (1999) studied the impact of a community based self-care management educational intervention for Spanish-speaking individuals with arthritis. While the information provided in the Spanish version of the educational
intervention was the same as found in the English Arthritis Self-Management Program (ASMP), cultural adaptation of certain portions were made for the Spanish population (exercises were first done as a group, information on the US health care system was provided). The 331 enrollees demonstrated both short and long term positive effects of the educational self-care management program related to improved health behaviors, overall health status, and reported self-efficacy.

The assumption that self-care has a central role in the elderly individual’s ability to perform self-care with a chronic condition was examined by Spitzer, Bar-Tal, and Ziv (1996). The 288 subjects enrolled in the study were required to exhibit at least one of three chronic health conditions: peripheral vascular disease, chronic obstructive pulmonary disease, or Parkinson's disease. The severity of illness symptoms was found to be positively correlated with age and negatively correlated with the amount of self-care performed. The authors concluded that age plays a significant role in self-care and the elders’ perceptions of control over their health.

Webster and Brennan (1994) examined the efficacy of self-care strategies among 138 patients with interstitial cystitis. Subject information was obtained on symptom relief, self-care management, and the effectiveness of the self-care interventions. The approaches reported being used by the subjects were then classified by the researchers as spontaneously developed or based on suggestions from others (e.g. health care personnel or other interstitial cystitis patients). Most subjects (68%) reported using calcium/magnesium supplements as a dietary intervention. Most subjects also reported
comfort interventions (wearing loose clothes, massage, heat to area, etc). The researchers concluded that use of interventions was directly related to the perceived effectiveness of the intervention. The authors again stated that little self-care outcome research has been done in this arena. Self-care as a concept has not yet been fully explored among elders.

Carroll (1995) studied the importance of self-efficacy (belief in one's own ability to perform actions successfully) on self-care in elders recovering from coronary artery by-pass surgery. The study participants were 133 adults between the ages of 65-87 years within a cardiac unit of an Eastern hospital. This investigator posited that decision-making mediates how people judge their capacity to perform self-care behaviors. The author noted that the lowest scores of self-efficacy and self-care behaviors were obtained from subjects at the time of hospital discharge. The score of self-efficacy was predictive of subsequent self-care behavior performed by the subjects as time passed.

Rose, Conn, and Rodeman (1994) studied the relationship between the state and trait anxiety for 62 myocardial infarction patients and self-care behaviors several weeks post cardiac event. Study findings revealed weak correlations among trait anxiety and activity levels, medication administration, stress management, and smoking. The authors suggested that conceptual differences between state and trait anxiety might be the reason for the weak correlations. The concept of anxiety is not often measured in persons with diabetes and may be an important factor related to learning diabetes self-care information.
Fried, Ettinger, Lind, Newman, and Gardin (1994) examined the self-reported physical disabilities and self-care activities of 5201 elders (age 65 or above) with cardiovascular problems. The study explored the extent to which standard measures (BP, resting heart rate, etc) are meaningful evaluations of underlying pathophysiology. The study determined that each of the 17 tasks of daily life tend to aggregate into four groups: 1) activity/mobility tolerance; 2) complex activities dependent on cognition and sensory input; 3) basic self-care activities, and 4) upper extremity activities. The researchers’ findings suggest that a re-grouping of tasks of daily life may provide a more refined outcome measure in evaluating self-care. The limited studies on self-care in elders with diabetes cluster around an "all or nothing" perception of abilities. Therefore, a redistribution of self-care tasks may provide a more reliable measure of an elder's self-care abilities.

Studies listed within this section illustrate that self-care educational management programs are effective in a variety of chronic conditions. This study examined how self-care among elders with diabetes related to their exposure to educational programs, their knowledge of their chronic condition, and their health literacy.

The measure of diabetes self-care selected for this research was the individual’s glycated hemoglobin (HbA1c) levels. Those who exhibited elevated HbA1c levels were expected to be lacking in some, or all, of the variables identified in the study and thus have a lower level of diabetes self-care management.
Studies Involving Factors that Influence Self-Care in Diabetes

A complex variety of factors (knowledge, socioeconomic background, cultural settings, relationship with health care provider) have been implicated as impacting on the individual’s ability to successfully engage in diabetes self-care management. The Diabetes Complication and Control Trial study demonstrated that tight glycemic control could reduce or delay the onset of diabetes complications in both type 1 and type 2 diabetes (ADA, 2002). McNabb (1997) examined the lack of a gold standard to measure adherence to a diabetes regimen in studies that supposedly measured this concept. The author’s central position was that no unified definition of diabetes self-care behaviors exists and there is also no validated measure of adherence to diabetes regimens. Complex diabetes routines are individualized to the point that McNabb holds it is not possible to develop an instrument that can adequately measure adherence. This lack of a recognized instrument has resulted in researchers relying on behavioral self-reports of persons with diabetes. McNabb also points out that while adherence to a diabetes regimen results in better glycemic control, several other authors contend that no such correlation exists (Nathan, 1995; Young, 1985). Glycated hemoglobin levels have been set as a standard of care by the American Diabetes Association at a level of 7%, corresponding to a blood glucose level of between 125-150 mg/dl daily for the prior three-month time period (ADA, 2002).

Most cases of type 2 diabetes occur in the elderly, yet few empirical studies have been completed on self-care as an outcome in this population. Studies completed on
diabetes self-care as an outcome have traditionally been conducted with individuals diagnosed with type 1 diabetes; however, a few studies have recently been completed involving subjects with type 2 diabetes (Bruce et al, 2000; Keyserling et al, 2002). Interest in type 2 diabetes and its impact on the individual and health care in general has lagged behind type 1 diabetes research studies. The studies that have been conducted with type 2 subjects have tended to focus of how lifestyle changes (diet and exercise) impact the disease process. However, these studies have not explored the type or qualities of education provided, nor have subjects been selected based solely on being older.

In 2003 Lauzon, Tudor-Locke, Myers, and colleagues studied the effectiveness of an exercise educational intervention with persons with type 2 diabetes. Of the 86 persons enrolled in the study the average age was 57 years. The participants were provided with educational material related to Canada’s First Step program (FSP) to increase walking in persons with diabetes. By the conclusion of the study, the participants demonstrated a significant reduction in body mass index; however, no data were collected that demonstrated increased knowledge about diabetes.

Whittemore, Chase, Mandle, & Roy (2002) examined how a nurse-coaching format could be employed to successfully bring about a lifestyle change in person with type 2 diabetes. The objective of the study was to explore the experience of integrating type 2 diabetes treatment recommendations into the subject’s existing lifestyle. The short-term positive impact of a nurse-coach for these changes was demonstrated. Long-term lifestyle changes among persons with type 2 diabetes were less likely.
Laffel, Brackett, Ho and Anderson (1999) studied 171 type 1 diabetic males, age 10-15, for two years to determine if participation in an intensive diabetes educational training program improved outcomes. The experimental group intervention was designed to help patients and their families with diabetes education, appointments, and concerns about billing through frequent phone contact. The control group received only standard diabetes educational material. A 50% decrease in the experimental group's glycated hemoglobin (HbA1c) and hospital admissions related to diabetes was realized during the study's two-year duration. The study report did not mention if any follow-up was conducted with subjects in subsequent years to assess the long-term impact of the intervention on diabetes self-care.

A few studies have examined how, or if, the type of client-provider relations, or the qualities of those interactions, impacted self-care or glycemic control in persons with types 2 diabetes. Anderson, Fitzgerald, Gorenflo, and Oh (1993) compared the diabetes-related attitudes of health care givers with those of patients. The researchers were testing the Diabetes Attitude Scale (DAS) to explore if physicians and patients have different views of diabetes training. Most persons with diabetes strongly supported diabetes specific training for health professionals, while most physicians felt the current level of training in diabetes was adequate. Those with diabetes were more likely to perceive comments on their glycemic levels as criticism of their self-care ability. Both groups viewed self-testing of blood glucose as a positive self-care measure.
However, studies have demonstrated that elders are less likely to be referred to diabetes educational programs or to have Self-Blood Glucose Monitoring suggested to them by their primary care providers than other age groups (Brown, Harris, Webster-Bogaert, Webster, Faulds, & Stewart, 2002; Croxson et al, 1994; Glasgow et al, 1991). This bias against elders performing diabetes self-care places the elders with diabetes at increased risk of developing diabetes complications.

Ciechanowski, Katon, Russo, and Walker (2001) examined 367 patients with type 1 and type 2 diabetes in an HMO setting. This work explored how the attachment of the client to the health care provider impacted individual glycemic control levels. If people with diabetes are to manage their conditions, then a positive relationship to their health care provider is an important condition. Basing their hypothesis on attachment theory, the researchers speculated that adults who had little attachment to health care providers and a dismissing attachment style would also exhibit poor levels of glycemic control. The study demonstrated a statistically significant relationship between glycosylated hemoglobin levels (HbA1c) and degree of attachment to provider. The higher the degree of attachment between the subject and the provider, the lower the subject’s HbA1c scores; hence the better the subject’s glycemic control. Those who rated their attachment to providers as poor overall demonstrated a higher glycemic index.

Ciechanowski, Hirsch, and Wayne (2002) studied 276 adults with type 1 diabetes to determine if their attachment to their health care provider impacted subject’s HbA1c level. The study demonstrated that 62% of those with a dismissing attachment style
displayed an HbA1c level of $\geq 8\%$, while only 32% of those subjects who reported a secure, positive relationship to their health care provider had HbA1c levels of a similar nature. The study stressed that, with 25% of adults in the study having dismissing attachment style, this factor might impact glycemic control for many.

Testa, Simonson, and Turner (1998) examined glycemic control and perception of quality of life in adults with type 2 diabetes and concluded that glycemic control positively impacts individuals’ perceptions of quality of life. Quality of life, fasting blood glucose, and HbA1c were measured in a sample of 569 individuals with type 2 diabetes. Subjects were invited to rate their current diabetes-specific health state and then to indicate at what point on the scale their disease symptoms would make living and working unmanageable for them. The subjects indicated that only a 27-point drop in the diabetes health states questionnaire scale rating would impact their ability to function significantly without impairment to their quality of life. The researchers concluded that the current instruments for measuring quality of life are too crude and insensitive to accurately capture important issues in diabetes self-management such as glycemic control.

Ongoing, validated diabetes educational resources and health care practitioners developing treatment plans in-line with the ADA diabetes standards of care recommendations was the focus of Renders, Valk, Franse, Schellevis, van Eijk, and van der Wal (2001). The researchers examined 312 subjects involved in a quality improvement program focused on patient outcomes and how diabetes self cares were
delivered. The program consisted of clinical practice guidelines, postgraduate education, templates for diabetes care along with the physiological markers of HbA1c, lipid levels, BP and number of subject annual visits. In this study the environmental factors of diabetes care (type of program, how education was delivered, and consistency of clinical practice) demonstrated that no statistically significant improvement in diabetes physiological was observed for either the experimental or control groups.

Norris, Engelgau, and Narayan, (2001) conducted a meta-analysis of effectiveness studies related to self-management training for those with type 2 diabetes. The authors examined 72 separate studies on self-management training. Positive effects were documented in knowledge of condition, frequency and assurance of self-monitoring blood sugar, dietary habits, and glycemic indices in those studies with an under 6 month follow-up of subjects. The researchers were unable to find any studies that were concerned with indirect costs, self-management training of diabetes related condition (cardiovascular, etc) or health care utilization. Evidence suggested that in the short-term (< 6 months) educational interventions and self-management training impact on an individual’s type 2 diabetes glycemic control. However, reported elevated glycemic indices for subjects in studies of greater than six-months duration did not evidence long lasting behavioral change. The issue of self-care diabetes education and its impact on diabetes control, however, appeared to be in doubt based on this meta-analysis. Several of the studies reviewed in the meta-analysis failed to demonstrate a positive relationship between self-care education and diabetes management that lasted longer than 6 months
post-intervention. The authors concluded that while short-term gains in glycemic control could be demonstrated by self-care interventions, further research into the impact of self-care interventions on long-term glycemic control is needed.

The numerous studies described in this section serve to demonstrate that diabetes self-care is impacted by a variety of factors. While different researchers have examined some of the proposed concepts, none has coalesced all into one study. The inter-related factors of age, glycated hemoglobin levels as a measure of glycemic control, and self-care have not been thoroughly examined by studies to date.

Studies Involving Basic Conditioning Factors

Orem defines basic conditioning factors as those factors such as age, gender, health care systems availability, education, family systems elements, and patterns of living that impact an individual’s ability to perform self-care. Problems of contextual diabetes self-care (care directed by the person with diabetes but administered by another non-medical person) in aging ethnic minority populations has not yet been adequately addressed in the literature. Current models of diabetes self-care instruction are centered in the philosophy that the individual, not a third party, cares for the condition. This research gathered data on the degree to which basic conditioning factors impact on the individual’s ability to perform diabetes self-care techniques. This section will examine studies about ethnicity, gender, and marital status as each relates to self-care and/or diabetes self-care management.
Ethnicity Studies. Brown, Garcia, Kouzekanani, and Hanis (2002) examined the effects of a culturally competent diabetes management intervention among 256 Mexican-American adults with type 2 diabetes. The intervention consisted of 52 hours of contact over a period of one year provided by bilingual Mexican-American nurses, dietitians, and community workers. The educational sessions focused on diabetes self-care topics including nutrition, self-monitoring, exercise, as well as group support sessions to promote behavioral changes. At the conclusion of the study the experimental group demonstrated HbA1c levels 1.4% under those of the control group; however, the mean level of the experimental subject’s’ HbA1c was still greater than 10%.

Diabetes self care among elderly minority subjects has been examined in a small number of studies. Researchers who have conducted the few empirical studies related to elders and self-care have reflected on the small amount of relevant literature. According to the work completed by Tucker, Bermudez, and Castaneda, (2000) a strong link exists between ethnicity and diabetes control in elders from the Caribbean. The researchers studied 863 elders (age 60-96 years) of both Puerto Rican and Dominican descent as well as contemporary elders of non-Caribbean ethnicities. The groups from the Caribbean demonstrated greater rates of type 2 diabetes, greater insulin resistance, and higher body mass indices than other ethnicities. These conclusions have led researchers to believe that some genetic or cultural variable (as yet unidentified) may be involved in glycemic control and diabetes self-care techniques.
The impact of glycemic control and self-care on the level of physical functioning of inner city minority elders was examined. Miller, Lui, Perry, Kaiser, and Morley, in 1999 studied the impact of physical activity and the subject’s perception of physical activity in elderly (age 70 and older) inner-city African Americans with diabetes and those without diabetes. Elders with diabetes were more likely to report poor health and difficulties performing activities of daily living (ADLs e.g. food preparation, dressing self, etc.) than those without diabetes. Multivariate analysis demonstrated diabetes was related to frequency of falls, decreased vision, and diminished light touch perception. The authors suggested the need for further research into the relationship between glycemic control and sensory function in elders.

Keyserling and colleagues, (2002) explored whether an intervention for increasing self-care activities could be made culturally appropriate for 200 African-American women over age 40 with type 2 diabetes. The study was composed of three groups (community-group, clinic-group, or minimal intervention group). The community group received the ongoing support of a peer counselor and frequent telephone contacts. The clinical group was provided with monthly visits with a nutritionist who helped them explore culturally appropriate food options. The minimal intervention group received a pamphlet in the mail. Reassessment was made at 6 and 12-month intervals, to demonstrate that subjects who had received the study intervention (diet and exercise) showed only a modest enhancement of self-care activity.
Fisher and colleagues (2000) concluded that the characteristics of the family unit of elders with diabetes had a significant link to self-care behaviors. The study examined 187 adults (who self-reported as having either Hispanics or other European ancestry) with type 2 diabetes for potential differences in the relationship between characteristics of family units and disease management and self-care practices. For subjects with European ancestry, gender, family worldview, and family emotional management were related to disease management and negatively associated with HbA1c levels. Among Hispanic subjects, gender and family organization were related to diabetes management. The study concluded that the characteristics of the family setting in which disease management takes place may be linked to self-care behaviors.

While it is acknowledged that diabetes type 2 is increasing in frequency among certain ethnic group, little research exists about the impact of culture on diabetes self-care. The demographic information gathered in this study included information on the country of origin and ethnicity of the subjects. These data were examined for potential correlations to diabetes self-care management and glycemic control.

Gender Studies. Polonsky, Anderson, Lohrer, Aponte, Jacobson, and Cole (1994) worked with 341 insulin-dependent females (ages 13-60 years) and demonstrated that 31% of the sample reported intentionally omitting their insulin on a regular basis. Two variables were discovered to independently predict insulin omission by the women: distress over the diabetic condition and fear that improved glycemic control will result in weight gain. These findings indicated that insulin omission is a common event and not
limited to only young women. While this study may indicate another potential factor that influences self-care (fear of weight gain), it demonstrated that there are differences in how individuals manage their diabetes self-care based on gender.

Fitzgerald, Anderson, and Davis (1995) studied 1201 subjects’ attitudes toward diabetes self-care. The study found no difference in the attitudes toward self-care among men and women with non-insulin dependent diabetes. The research concluded that men and women may react similarly to the diagnosis of diabetes.

Williams (1999) found that maternal support for the male adolescent with diabetes was greater than that provided to female adolescents with diabetes. Males with diabetes then may be more dependent in self-care if they have been exposed to the notion of females being responsible for health care.

Dean (1989) examined the self-care practices of individuals over the age of 45 years. The study showed that gender (being female) was a major independent influence on the pattern of health maintenance behaviors and social network variables assumed prominence for self-care responses to illness.

Gender then may be an issue in how an individual reacts to and manages a chronic condition. Like most research on diabetes most gender related diabetes studies have been conducted with the type 1 population of children and adolescents. The research gathered information on the subject’s gender and age in relation to self-care management practices.
Marital Status Studies. A literature search of OVID, MEDLINE, CINAHL, and PsychINFO demonstrated that there are few research studies on how marital status impacts diabetes self-care. Works on marital status and other chronic conditions are included in this discussion to serve as a basis for potential relevance to diabetes self-care.

Trief, Himes, Orendorff, and Weinstock (2001) examined 78 adults with type 1 and type 2 diabetes to explore the relationship between glycemic control and marital relationship status. The study found that subjects with better marital satisfaction had correspondingly better scores on the quality of life with diabetes questionnaire. No correlation was evidenced between glycemic control and marital status.

Hubbard, Muhlenkamp, and Brown (1984), when studying the social support and self-care practices of 97 community dwelling elders (age 55 and greater), found that individuals who were married scored higher on the social support and health practices study tools than their single counterparts.

Martire, Stephens, Druley, and Wojno (2002) focused on older women with arthritis and their reactions to spousal care. Women who did not value self-functional independence rated the amount of support from their husbands highly.

The living conditions under which individuals with diabetes reside impacts their diabetes self-care performance. Studies have demonstrated that strong social support for those with chronic conditions like diabetes has a positive impact on self-care.
management. Demographic data on subjects' marital status was gathered in this research to explore links to self-care management.

Studies on Diabetes & Developmental Deficits

Age related deficits and their impact on self care have been explored in a variety of studies and with various physical conditions. This section will provide information on research of visual acuity, cognition, and manual dexterity in relation to self-care. While the issues of visual acuity, cognition, and manual dexterity have been explored related to other conditions, there is little literature that ties any one of these three components to the self-care issue for persons with diabetes.

Studies on visual acuity.

A literature search of OVID, MEDLINE, CINAHL, and PsychINFO demonstrated that there are few research studies on how visual acuity impacts diabetes self-care. Works on diabetes impacts vision are included in this discussion to serve as a basis for potential relevance to diabetes self care.

The level of independence in self-care for elders with diabetes has been explored in studies related to vision self-care and foot self-care (Bernbaum et al, 2000; Umeh, Wallhagen & Nicoloff, 1999). Overall these studies have concluded that if educational interventions related to self-care are targeted early in the disease trajectory, elders tended to have low rates of visual impairment and to maintain independence in self-care behaviors for longer periods.
Berbaum and colleagues (1989) conducted a small study (29 subjects) to examine the effectiveness of a program designed for blind, diabetic patients. The 12-week program was designed to improve subject independence and self-esteem as well glycemic control. A series of monitored exercise sessions, educational interactions, and group support were employed. Subjects lowered glycated hemoglobin levels and improved their activity tolerance. Elevated Diabetes Self-Reliance test scores documented increased feelings of self-esteem.

Verrotti, Lobefalo, Chiarelli, Mastropasqua, Ciancaglini, and Morgese (1995) worked with 50 children with type 1 diabetes in an attempt to elucidate color vision changes as a predictor of retinopathy related to the condition. Utilizing the Farnsworth-Munsell 100-hue test a significantly higher total error score was noted among the children with diabetes as opposed to the control groups. Fluorescent angiographic did not detect the presence of retinopathy in any of the subjects. The children with the lower color vision scores were then tested for microalbuminuria (within normal range) and glycated hemoglobin (within normal parameters) and followed for seven years. The results suggest that a color deficit occurred prior to the onset of any other sign of retinopathy.

To date no similar testing of color reduction has been undertaken with a large number of elders with diabetes. However, Roy, McCulloch, Hanna, and Mortimer (1984) did a very limited study (12 subjects) of adults with type 2 diabetes to examine the impact of diabetes on color vision. The researchers scored the 100-hue color vision test and
related it positively to the subjects' degree of retinopathy and negatively to glycemic control. However, the study did not find any significant difference in the degree of color vision loss between the diabetic and control subjects.

Independent functioning of elders with decreased visual acuity declines over time. Studies have demonstrated that elders can positively benefit from early detection of vision loss through diabetes educational programs geared to vision information. While there are studies that examine the physiological vision changes that accompany advancing diabetic complication, no study has examined how decreased visual acuity impacts an elder’s ability to perform self-care management. This doctoral research documented the elders' visual acuity through measurement of the Snellen test of visual acuity.

Studies on cognition.

A literature search of OVID, MEDLINE, CINAHL, and PsychINFO demonstrated that there are few research studies on how cognition impacts diabetes self-care. Works on cognition and other chronic conditions are included in this discussion to serve as a basis for potential relevance to diabetes self care.

Linderman and colleagues (2001) explored whether elders with type 2 diabetes where at risk for cognitive impairment. Both elderly Hispanic (n= 414) and non-Hispanic whites (n=416) were included in this study. The researchers gathered information on two measures of depression and nine measures of cognition. Holding age, gender, educational level, and presence of depression as constants, the study did not demonstrate any
increased risk for cognitive impairment between those with diabetes and those without the condition.

Coker and Scumaker (2003) reviewed 32 studies that reported the effects of type 2-diabetes on cognition. The authors found that a majority (30 of the 32 studies) included women with type 2 diabetes and that those respondents performed worse on at least one neurophysiological test than their non-diabetic counterparts. The researchers suggested that gender be a considered factor in future studies on cognition and diabetes related to the lack of documentation on how gender may be impacting neurophysiology.

Gispen, Hendrick, Biessels, and Geert-jan (2000) examined in animal models the changes in hippocampal synaptic plasticity related to glycemic levels. Because impairment of spatial learning is associated with changes in hippocampal synaptic alterations, such informational processing may be similar in humans. Since the complete impact of aging on the brain and the development of diabetic neuropathy within brain neural connections has had limited attention from researchers in this area, this animal model may indicate a potential future area of study.

Cognition, according to Allaire (2001), among elders consists of fluid intelligence (basic mental abilities to process and understand abstract relationships and patterns), and crystallized intelligence (accumulated general knowledge gained through formal education and acculturation). Recent studies on cognition and diabetes among elders have demonstrated contrasting results (Berry, 1996; Coker & Scumaker, 2003; Linderman et al, 2001). However, since diabetic complications include neuropathy, some impact on
cognitive ability related to the length of time with the condition, cannot be overlooked. The proposed study examined how elders process everyday information as a measure of cognition.

Studies on manual dexterity.

A literature search of OVID, MEDLINE, CINAHL, and PsychINFO demonstrated that there are few research studies on how manual dexterity impacts diabetes self-care. Works on manual dexterity and other chronic conditions are included in this discussion to serve as a basis for potential relevance to diabetes self-care.

The Diabetes Control and Complications Trial (Anonymous, *Annals of Neurology*, 1995) examined if intensive insulin treatment could delay the onset of neuropathy. This study involved a total of 1,441 subjects randomized into the experimental arm of intensive insulin treatment or conventional insulin treatment. Nerve conduction studies were performed at the beginning of the study and conclusion five years later. Significant nerve conduction differences were observed between the intensive and conventional treatment arms of the study related to the onset of neuropathy. A delay in the onset of peripheral neuropathy would suggest that manual dexterity would potentially be positively affected.

Maser, Laudadio, and Decherney (1993) evaluated the association between age and vibratory thresholds in diabetic and non-diabetic subjects above the age of 45 years. While the modality to large sensory nerve fibers increased with age regardless of the presence of diabetes, the increase in nerve compromise and age of onset were greater in
persons with diabetes than in those without the condition. This seeming acceleration of the aging process among persons with diabetes may impact their ability to perform self-care.

Lehtinen, Niskanen, Hyovnen, Siitonen, and Uusitupa (1993) studied the changes in nerve function in 113 type 2 subjects and 127 non-diabetic control subjects. Motor and sensory nerve conduction velocities were measured at the time of diagnosis and 5 years later. The differences in rate of nerve conduction at the conclusion of the study demonstrated that persons with diabetes had slower conduction rates, and those persons with poor glycemic control had the most neurophysiological impairment.

Two measures of manual dexterity were gathered in this doctoral research: The Jebsen-Taylor Test of Hand Coordination and Finger Stick Technique for Blood Sampling. Individuals who lack sufficient grip strength or manual ability to manipulate objects such as blood glucose monitoring equipment were expected to have a higher glycated hemoglobin level, thus indicating a lower level of diabetes self-care management.

Summary of Diabetes Self-Care Among Elderly.

Researchers have used various ways to study diabetes self-care among elders. The physiological alterations that accompany the aging process (decreased vision, alterations in cognition, and slowing manual dexterity) may impact elders’ physical ability to perform self-care management.
Studies of Glycated Hemoglobin (HbA1c) Testing and Diabetes Self-Care

Glycohemoglobin (HbA1c) is a term utilized to describe a series of stable minor hemoglobin components that are slowly and nonenzymatically formed in the presence of hemoglobin and glucose. Since erythrocytes are freely permeable to glucose, the concentration of glycohemoglobin is directly proportional to the ambient glucose concentration of the subject for the approximate 120 days life span of the erythrocyte. Since HbA1c testing reflects the average glycemic level for the preceding three months, the American Diabetes Association (2002) is now utilizing this test as a minimum standard of care. Periodic testing of a person’s HbA1c level (either quarterly or twice a year) permits the physician and the person with diabetes to determine if the target range for the subject’s metabolic control has been achieved. Currently the recommended standard of care for HbA1c from the American Diabetes Association is <7% (average plasma blood glucose mg/dl). Numerous studies have utilized the American Diabetes Association’s recommended glycated hemoglobin level of <7% as their basis of assessing overall glycemic control (ADA, 2003).

Recent studies have shown a trend linking glycated hemoglobin level with self-monitoring blood glucose practices and the level of diabetes self care. Ozmen and Boyvada (2002) studied 315 adults with either type 1 or 2 diabetes to investigate if an intervention aimed at self-monitoring blood glucose levels impacted HbA1c over the period of 1 year. The difference in the education material provided to each group from the ADA standard diabetes educational material was the review of skills needed to
performing daily monitoring. Study results demonstrated that only some patients evidenced a decrease in HbA1c levels at the one-year follow-up. A study limitation was its focus on the technical aspects of diabetes self-care rather than on comprehension and application.

Franciosi and colleagues (2001) investigated the association between self-monitoring of blood glucose, metabolic control, and degree of anxiety/depression among 2,855 type 2 patients. While 41% of the study subjects reported performing self-monitoring blood glucose at home on at least a daily basis, the multivariate analysis demonstrated that frequent monitoring was significantly related to high levels of anxiety and depression. The researchers posited questions about needing to stress psychological factors (anxiety/depression impacting on HbA1c levels) in diabetes educational programs.

Burton and Connerty (1998) studied the impact of an educational intervention for diabetes based in the worksite of 53 employees of a banking entity. Identification of potential subjects was through the company’s insurance carrier claims listings for type 1 and type 2 diabetes services. Presented to the employees on a voluntary basis were a series of 5 noon-time seminars covering diabetes self-care educational material. Prior to the educational sessions the subjects completed diabetes knowledge questionnaires and short health histories, as well as agreeing to blood testing of current and three-month glucose levels. While greater than 82% of the study participants rated their level of self-
care as “average” after the intervention, more than 77% had glycosylated hemoglobin levels greater than the ADA recommended 7%.

Norris, Lau, Smith, Schmid, and Engelgau (2002) performed a meta-analysis of studies focused on the efficacy of self-management education for those with diabetes. The authors discovered that regardless of the exact nature of the educational intervention involved, study participants demonstrated, at least initially, improved HbA1c levels. However, the difference in HbA1c values between experimental and control groups decreased as time from the educational interventions was increased. The authors called for additional research studies to develop effective interventions in maintaining long-term glycemic control.

Trief, Grant, Elbert, and Weinstock (1998) studied the influence of family systems on the metabolic control of adults with type 2 diabetes. Utilizing a sample of 150 families possessing an adult member taking insulin, the researchers examined family cohesion, glycemic control and psychosocial adaptation. The findings demonstrated that subjects with advanced age and longer disease duration had higher HbA1c values. When family members were supportive of self-care issues, then the individual family members were more likely to express satisfaction with his/her adaptation to the condition. The study demonstrated that for those with insulin-dependent diabetes, family systems were not related to glycemic control, but were indicative of psychosocial adaptation.

With the recommendation for diabetes standard of care being set by the ADA as an HbA1c of 7%, self-care among persons with diabetes is now tracked by this
physiological marker. Researchers have demonstrated the impact of various intervention programs related to diabetes self-care management on HbA1c levels. The proposed study utilized subjects’ HbA1c levels as an indicator of their daily levels of glycemic control against which the study’s other factors were assessed.

Studies of Knowledge of Diabetes as a Disease

Knowledge of diabetes has been the traditional outcome employed by most diabetes educational programs. Participants, by the conclusion of standard diabetes educational programs, are expected to be able to recite the symptoms of hypoglycemia and hyperglycemia, to list food types and amounts that may be consumed, and to perform finger-stick and glucometer testing. Testing for pre-instructional knowledge of diabetes, or the client’s level of literacy, is rarely undertaken in a standard diabetes educational course. Post-instructional testing may be completed immediately following presentation of the material; however, almost no follow up testing at periodic intervals to assess diabetes knowledge or self-care techniques are ever undertaken in standard diabetes educational programs. Diabetes educational programs have not emphasized on-going education for persons with diabetes as new knowledge of the condition is brought forth by scientific discovery. This lack of reassessment and re-education for those previously trained in diabetes self care management places these individuals at a disadvantage related to their diabetes care.

Roman and Chassin (2001) examined the knowledge of 289 persons with diabetes admitted to an acute care facility for diabetes-related co-morbid conditions. The study
examined the frequency of hospital admission for severe hyperglycemia (>400mg/dl) and diabetes knowledge levels. Between 44-69% of the subjects reported that they had received diabetes self-care information prior to hospital admission. The results of this study demonstrated that 40-45% of study participants had significant gaps in their knowledge related to their diabetic condition, including being unable to state their recommended blood sugar range or when to seek care from a health professional. Yet 72% of the study subjects rated highly their confidence level in managing their diabetes.

Brown, Harris, Webster-Bogaert, Wetmore, Faulds, and Steward (2002) examined, in a qualitative study, the interrelationships between the patient and physician in the management of type 2 diabetes. The study posited that, if indeed the majority of those with type 2 diabetes were receiving their diabetes care from their family physician, then how the physician viewed the self-management of diabetes was of paramount importance. The researchers utilized focus groups of physicians and those with type 2 diabetes to explore the issues of adherence to and barriers to diabetes care. Patient issues of adherence included needing diabetes care information early in the process as well as having prior experience with the disease through a close family member or friend. Physician focus areas identified primary care physicians as being the most appropriate venue for care and the need for ongoing re-education in diabetes standards of care as those standards evolved. The central concept of educating patients and medical personnel at every opportunity was stressed as being a cornerstone of diabetes management by the researchers.
Raji, Gomes, Beard, MacDonald, and Conlin (2002) explored the level of educational intensity that may be most effective for those with type 2 diabetes. The researchers posited that a single, intense group educational program would improve HbA1c in subjects when compared to a passive educational format. The 106 adult subjects (mean age 60.3 years) were recruited from the Veteran’s Hospitals near Boston and randomized to either the intensive diabetes educational program or to the standard diabetes educational format. The study did not demonstrate any statistically significant difference in the group’s HbA1c levels at any measurement point. Both groups demonstrated a drop in HbA1c levels following the educational program; however, the format of the education did not appear to have any effect on the subjects' level of glycemic control. This study did not address the motivational issues for learning or practicing diabetes self-care.

Yung, Tse, Chang, and Chow (1998) studied 126 elders (age 50-82) with type 2 diabetes to assess the relationships among age, knowledge of diabetes, hypoglycemic symptoms, and medical treatment adherence. The study findings demonstrated that among the 103 subjects who reported having diabetes educational classes prior to the study, the scores of diabetes knowledge and awareness of hypoglycemic symptomology were lower with advancing age and also declined based on the length of time since diabetes educational session occurred.

Increasing an individual’s knowledge of diabetes has been the chief goal for diabetes educational programs to date. However, few diabetes educational programs are
structured to initially screen a person’s diabetes knowledge level or to reassess the subject’s knowledge of diabetes once the individual has completed the educational program. The current standard for diabetes education from the ADA is that anyone diagnosed with diabetes is to be provided with ongoing diabetes instruction from an expert in diabetes care management. While the ADA has recommended standard guidelines for diabetes education these are only recommendations and are often not followed in diabetes educational programs (ADA, 2003). Studies centering on diabetes and self-care have demonstrated that only increasing an individual’s knowledge of his/her diabetes does not necessarily positively impact the trajectory of the disease self-management over time (Miller et al, 1999; Raji, Gomes, Beard, MacDonald, & Colin, 2002; Yung, Tse, Chang, & Chow, 1998). Yet most diabetes educational programs rely heavily on an educational platform that imparts information to subjects without any type of educational re-assessment of information learned once subjects leave the program.

Factors that Influence Diabetes Knowledge Acquisition

Researchers have examined issues that arise when testing subject’s knowledge of diabetes. For example, Corkery, Palmer, Foley, Schechter, Fisher, and Roman (1997) studied the impact of having a bicultural health care worker as a part of the educational team for Hispanic clients with diabetes, but found no statistically significant differences in knowledge of the subjects based on the ethnicity of the educator. Researchers in the U.S. and in the United Kingdom have examined the impact of the knowledge of the
health professionals and the knowledge of the diabetic subjects on diabetes as a disease condition as it diabetes self-care management. Sinclair, Allard, and Bayer (1997) and Speight and Bradely (2001) found that for both professionals and those with the condition, diabetes knowledge was significantly lower than the researchers expected and that referrals to health professionals with expertise in diabetes rarely occurred.

Currently few studies examine the impact of knowledge of diabetes as a chronic condition on self-care behaviors. However, the ADA has set a recommendation that all persons diagnosed with diabetes receive diabetes related educational information from a health professional who specializes in care for this population. The studies that have been conducted to measure the impact of knowledge on self-care have tended to show that some association between these two concepts exists, but disagreements have arisen on the nature and degree of that relationship. Common sense would argue that increased knowledge of a disease state would serve as a factor in determining how the individual manages that state. Missing from the literature are sufficient studies examining how aging impacts learning about diabetes self-care; the affect of literacy on the learning and retention of diabetes related information; or how cultural influences may support or impede the learning of diabetes self-care information.

Studies of Health Literacy

The self-care movement in this country has been based on the assumption that the population is basically literate and possesses adequate health literacy. In 1999 the American Medical Association Council on Scientific Affairs examined the issue of adult
health literacy in the U.S. The committee conducted both a review of the literature (published and unpublished) as well as interviews with experts in the field of literacy. The committee concluded that patients with inadequate health literacy exhibited a variety of communication difficulties with health care providers that could adversely impact complex medical conditions as well as increase risk of hospitalizations (JAMA Council on Scientific Affairs, 1999). Studies completed by various researchers mirror the results of the council, documenting that those with the highest rates of chronic disease (asthma, HIV, diabetes, heart disease) often exhibited the least ability to read and comprehend information related to their condition.

Researchers exploring self-care in type 2 subjects have found that inadequate health literacy was positively correlated with decreased glycemic control. The level of glycemic control was then correlated to the individual’s perception of quality of life. Schillinger and colleagues (2002) studied 408 adults in the San Francisco area with type 2 diabetes to examine the link between health literacy and diabetes outcomes. With primary care physicians treating more than 90% of those diagnosed, the researchers utilized two primary clinics affiliated with a public hospital to recruit study subjects. Employing the subjects’ most recent HbA1c as the outcome measure of glycemic control in the study, the researchers concluded that health literacy was independently associated with poor glycemic control. Study subjects’ HbA1c values only increased by 0.02 (p = .02) with a 1-point rise in their TOFHLA scores. However because the study was conducted with subjects who were actively receiving medical care, the degree of the
association between inadequate health literacy and diabetes outcomes resulting from events happening prior to or after the subject’s clinical presentation, was weakened.

Baker, et al. (2002) examined the level of functional health literacy and the risk of hospital admission for 3260 new Medicare enrollees in four U.S. cities. Baseline demographic information as well as the scores on scales for depression, self-rated physical health and social support was gathered, along with the shortened version of the test of functional health literacy in adults. Participants who demonstrated poor literacy tended to be older, non-whites with lower educational and socioeconomic levels. Subjects with inadequate literacy were more likely to be hospitalized than were those with adequate literacy. Years of completed education were not significantly associated with risk of hospital admission.

Williams, et al. (1995) explored the relationship of an individual’s level of reading and numeracy task abilities to their ability to function adequately in health care settings. The study sample consisted of 2659 mostly minority and indigent patients at two large urban acute care settings. Subjects completed the Test of Functional Health Literacy in Adults (TOFHLA). The TOFHLA possesses good internal consistency (Cronbach’s alphas 0.98) and validity (correlation coefficient 0.74 with the Wide Range Achievement Test). Study findings demonstrated that 41.6% of the subjects were unable to comprehend directions for taking medications, 26% were unable to understand information regarding appointment dates and times; and 59.9% did not understand a
standard consent document. The prevalence of marginal functional health literacy among elders (age above 60 years) was 81.3% higher than for younger age groups.

Kalichman, Ramachandran, and Catz (1999) tested the significance of health literacy to a subject’s level of adherence to antiretroviral treatment for HIV/AIDS among 184 adults with these conditions. Subjects underwent the TOFHLA, an interview to gather demographic information, and self-measure of HIV treatment adherence. Health literacy was examined for its association to the subjects' perceived barriers to HIV treatment adherence. Results of the logistic regression demonstrated that those from ethnic minorities, those with less than 12 years of schooling, less social support and lower literacy were three to four times more likely to be nonadherent to HIV treatment plans.

Schillinger and colleagues (2002) found that, among the 408 study subjects who spoke English and Spanish with type 2 diabetes, inadequate health literacy was independently associated with poor glycemic control and increasing rates of retinopathy. Inadequate health literacy was most prevalent among Spanish speakers from lower socioeconomic levels.

French and Larrabee (1999) enrolled 56 adults in a study to explore the relationship between perceived benefit and the material readability indices of hypertension educational materials. Subjects completed the SORT-R to estimate their reading level. Level of perceived quality of educational material was measured by a content validated questionnaire. A gap was discovered between the reported years of education completed and the subjects' actual reading level. A positive relationship existed
between measured reading level and the perceived benefits of the educational material provided.Traditionally the highest academic grade level achieved has been utilized as the measure of literacy of the individuals. However, studies (Davis et al, 1993; Wilson, Racine, Tekieli, & Williams, 2003) show the actual level of reading can be as many as 5 grade levels below the highest reported academic level achieved. The conclusion of various researchers is that grade level is not an indicator of an individual’s level of literacy. This has relevancy for diabetes educators who utilize highest grade level as an indicator of reading ability and health literacy.

Busselman and Holcomb (1994) examined the relationship between reading skills and comprehension of dietary guidelines in 62 adult participants of a supplemental food program: Women, Infants, and Children (WIC). Instruments utilized for this study were the Wide-Range Achievement Test-Revised (WRAT-R) and Cloze Test for Comprehension. The control group was provided with the standard dietary guidelines (reading index 10th grade) written by the US Food and Drug Agency, while the experimental group was provided with the dietary information written at a 7th grade reading level. Study results indicated a statistically significant difference between the experimental and control groups related to reading and comprehension of the dietary guidelines.

If individuals with inadequate health literacy exhibit communication problems with health professionals, then it is logical to assume that these same individuals may have difficulties with processing health care information into health care knowledge.
Baker, Parker, Williams, Clark, and Nurss (1997) focused on the reading level, perceptions of health, and utilization of health care services of adults in two urban hospital settings (1271 patients in Atlanta and 979 patients in Los Angeles). Utilizing the test of Functional Health Literacy in Adults the researchers found that self-reports of health are closely associated with the individual’s level of literacy. Years of schooling was not correlated with either literacy levels or perception of health. Utilization of the health care system in this study was not predicted by level of literacy. Elders with lower overall literacy may not possess the necessary skills to successfully navigate today’s health care system or to receive the complete benefit of printed self-care disease management information (Gazmararian et al, 1999).

Davis, et al. (1991) examined 151 adults to explore the role of reading literacy and the readability of patient educational materials. Subject demographics (age, gender, years of education) were correlated with the subject’s score on the Peabody Individual Achievement Test (PIAT). The PIAT is a wide-range screening measure of achievement in general academic subjects. Among the sample results of reading levels ranged from 5th grade and 4th month to 10th grade and 8th month. Analysis of the educational material available for distribution to the general public at the research site as well as medical forms indicated that these materials had readability indices (eleventh to fourteenth grade) far above the reading comprehension levels of the study subjects. There appears, then, to be support for a link between individuals’ level of health literacy and their ability to process health related information into a form in which they are able to draw on to correctly perform health self-care management techniques.
Few studies link the concepts of age with diabetes and health literacy. Williams, Baker, Parker, and Nurss (1998) examined the relationship between individuals' knowledge of their diabetes treatment plan with their level of health literacy. The majority of study subjects were over age 50. Those with adequate health literacy (94%) were able to state the symptoms of hypoglycemia as compared to those with less than adequate health literacy (<50%). The few studies conducted with elders indicate health literacy may decline with age. However, researchers are uncertain if this effect is related to one or more physiological factors such as general cognitive decline or physical impairment. Williams and colleagues proposed that, whatever the cause of the low health literacy levels in elders, this condition was detrimental to the elder’s health.

Baker, Gazmararian, Sudano, and Patterson (2000) interviewed 2774 elders (age ≥ 62) for functional health literacy levels. They gathered information on years of education, age, chronic conditions present, how often the newspaper was read, and health status. Instruments utilized were the Short-test of Functional Health Literacy in Adults (S-TOFHLA) and the Mini Mental State. The scores on the S-TOFHLA demonstrated a decline of 1.4 points for every year increase in age. Adjustment for decreasing visual acuity, chronic mental conditions, and health status did not explain the lower literacy in the sample subjects.

Gazmararian and colleagues (1999) studied the functional health literacy of Medicare enrollees in a managed care organization. Overall 33.9% of English-speaking and 53.9% of Spanish speaking respondents had marginal or inadequate health literacy.
Authors concluded that many elders may lack the necessary literacy skills to function adequately in health care environments.

Gazmararian, Baker, Parker, and Blaszer (2000) examined 3260 newly enrolled Medicare patients for their level of health literacy and presence of clinical depression. Those with limited health literacy had a 2.7 times greater chance of being clinically depressed. However, after the researchers controlled for health status the correlation between depression and health literacy was not as strong.

The literature acknowledges links among low levels of health literacy and increasing risk of hospitalizations and complications from chronic conditions. If increasing self-care management among persons with diabetes is the ultimate goal of diabetes education, then the level of health literacy of the program participants should be a key point.

Summary Chapter 2

A search of the literature failed to produce any studies that dealt with the effect of physical limitations on elder persons’ ability to perform diabetes self-care management. There was also little research on how elderly persons' cultural background may impact their ability or desire to perform diabetes self-care. While it is acknowledged that low levels of health literacy negatively impact the ability of those with a chronic illness to deal with the health care system, almost no research has been done on health literacy and diabetes.
Elders have participated in traditional diabetes educational programs with mixed results. Studies completed on the relationship of diabetes knowledge on glycemic control have demonstrated that while this is an important factor in curbing diabetes complications, no conclusive evidence demonstrates elders (or any one else) retain diabetes self-care information for extended periods. Recent studies have demonstrated that the individual’s level of health literacy does impact diabetes self-care, but there are currently few studies that focus on how health literacy, age, and exposure to diabetes education interact to affect diabetes self-care management.

Diabetes self-care among elders is a subject that is not well described in the literature. The entire issue of self-care is littered with controversies. Should all persons with chronic conditions assume self-care? If the individual comes from a culture where self-care is not valued, should the health professionals still insist that this person assume care of their chronic condition? Other issues within the literature base also exist related to elders and self-care of chronic conditions.

The literature base has not adequately defined the exact characteristics of self-care within an elderly population. Related to diabetes self-care, the central tenet that self-care improves overall glycemic control has proponents on both sides: those believing self-care has a positive impact on glycemic control and those whose research has failed to demonstrate any sort of link between self-care and glycemic control.

Diabetes self-care is a series of tasks and judgments about those tasks undertaken by the individuals to impact their condition. Some studies have demonstrated a positive link between self-care and glycemic control (O’Connor, Crabtree, & Abourizk, 1992;
Peyrot & Rubin, 1994). According to the Diabetes Complication and Control Trial (DCCT) an improvement in glycemic control for persons with diabetes correlated to a decreasing chance of the development of diabetes complications. To date there have been few studies of self-care educational conducted within elderly populations. Of the few diabetes related studies conducted within this age cohort, it appears that diabetes self-care as an outcome has been measured indirectly by improved glycemic control, positive perceptions of quality of life, and maintaining independence. Without a theoretical knowledge base of diabetes self-care information developed for their age cohort, elders are at a disadvantage in their health care.
CHAPTER THREE
METHODOLOGY

Introduction

This chapter will discuss the design of the study, including the sample selection, data collection and the instruments administered to the study participants. An explanation of the method of data analysis as it relates to the study, research questions and posited hypothesis are also included.

Research Design

This study employed an ex post facto (operating retroactively), correlational descriptive design. The study employed causal modeling to test hypothesized theoretical assertions.

Causal modeling employs analysis techniques which are based on correlation. Correlation studies permit researchers to examine the strength and direction of relationships between study variables. Correlation does not mean causation. Correlation techniques such as regression analysis are useful when conducting exploratory studies to determine if relationships exist among variables. Using regression analysis as a basis for quantifying the proposed relationships among the study variables, this study explored whether the data supported the hypothesized relationships.

There are four major assumptions underlying correlational studies (Gravetter & Wallanu, 1991). First, the sample is assumed to be representative of the population to which inferences will be made. Second, the variables being correlated are assumed to
have a normal distribution. Third, there is an assumption that each variable corresponds to the principles of homoscedasticity (equal variance of errors). Fourth, a linear relationship between the variables is assumed to exist.

Multiple regression analysis, a correlational technique, may be employed to explain relationships among one dependent variable and several observable independent variables. Using both descriptive and inferential statistics this methodology is used to summarize and examine study data for statistically significant trends. Multiple regression is employed when the study contains questions about the nature of the relationships between one dependent variable and several independent variables that are not directly under control in a laboratory setting.

Multiple regression has two major limitations and several basic assumptions to its utilization over all (Loehlin, 1998). First, all the predictions that are based on linear regression are not necessarily correct. They are a best guess based on a theoretical model. Second, a correlation between two or more variables within a multiple regression analysis does not necessarily imply causality. Multiple regression is at its core a technique of correlation. Assumptions are as follows. The data involved must be normally distributed to the regression line. The independent variables should be justified theoretically. It is a one-way analysis in that while the independent variables can predict the dependent variable, the dependent variable cannot predict the independent variables. Each independent variable should have strong correlations with the dependent variable but only weak correlations with other independent variables.
The use of multiple regression for this study was based on the ability of this methodology to consider the relations among the dependent variable of diabetes self-care management and the independent variables of aging, prior exposure to diabetes education, basic conditioning factors, and health literacy. The model suggested has a strong theoretical background.

Sample and Study Inclusion Criteria

This study employed a convenience sample of elders who resided in two metropolitan areas. The subjects were a subset of older persons with type 2 diabetes living in the Southwest. Study inclusion criteria were as follows: age 62 or greater; self-reported as performing diabetes self-care; a stated desire to be included in this study; and successful completion of study screening criteria.

The procedure for completing the study screening criteria began with the elder self-referring for study participation based on seeing an advertisement for study participants posted within senior centers. After identifying themselves to the researcher as possessing the basic qualifications for study participation (age 62 or greater, self-reporting as having type 2 diabetes, and performing self-care for diabetes) each elder was required to complete further study screening. Potential study subjects were asked to read randomly selected sentences within the study consent form and to answer questions related to that reading to gauge their ability to read and speak English at the 6th grade level in accordance with the set minimal literacy level for adult informed consent. Manual dexterity of each participant was screened by having the person manipulate paper
and pen to sign the study consent. Each participant’s basic cognition level was screened using the score on Mini-Mental State Examination (MMSE) of 23 or greater as standard level of orientation within clinical practice.

Sample Size

The sample size was calculated as a function of relevant effect size in regression analysis. The difficulty in setting a reasonable a priori value to these factors in multiple regression analysis has lead to the creation of several rules of thumb related to sample size (Maxwell, 2000). Since no one rule of thumb method is considered to be superior to another, the sample size for this study was set at six predictor variables with 10 subjects to be recruited per variable (60 subjects required for statistical significance).

A power analysis to determine the number of study participants needed was also utilized. Conventionally the value of alpha is set at 0.05; the larger the value of alpha the greater the probability of finding a significant result. The effect size in regression analysis is equal to $R^2$. Using Cohen’s advocated 0.8 as the level of power ($R^2 = 0.02$ small effect; $R^2 = 0.13$ medium effect; and $R^2 = 0.26$ as larger effect) due to the improbability of reaching unity yielded a $\beta = 0.2$ and $\alpha=0.05$. This implied that for this study a type II error was about $\frac{1}{4}$ as serious as a type 1 error (falsely stating that an effect exits when it does not). For a medium effect size a minimum of 64 adults with type 2 diabetes was required. Allowing for drop-out or disqualification a sample size of 75 adults was targeted for recruitment.
Sample Recruitment

Subjects were recruited at various senior centers and assisted living facilities within the Phoenix and Tucson metropolitan areas. A letter of interest describing the study and the reasons for seeking voluntary participation was sent to the directors of the Senior Centers and Senior Assisted Living Facilities. Those facilities that responded positively were utilized as recruitment sites. A poster and set of flyers announcing the study were distributed and posted within those facilities that expressed an interest in participating at least two weeks prior to the study.

Human Subjects Protections

Study approval was granted from the Institutional Review Board (IRB) of the University of Arizona on February 10, 2004. Subjects were assured participation was completely voluntary and a subject was free to withdraw from the study at any point without penalty. Subjects were also assured that all information collected was confidential. Data were identified only by number; no identifying personal information was reported. The subject received the results of the HbA1c test at the time of the testing. No formal method for informing the subject’s primary care provider of the HbA1c test results was undertaken in this work. Only this researcher and her dissertation committee members had access to the identified study data. No financial reimbursement was provided to the subjects for study participation.
Study Procedure

Elders who expressed an interest in study participation were first informed of their rights as human subjects and asked to sign the informed study consent by the primary investigator (Appendix A). Screening for study inclusion in the above section was outlined for each subject. Once an elder was positively screened for study participation, the procedure for the study was initiated. Screening and study testing was accomplished at participating Senior Centers and/or Assisted Living Facilities. Since the study testing occurred in public areas, the researcher provided a set of portable screens, table and chairs to conduct the study. Elders completed first the set of study questionnaires including demographic information, the short test of functional health literacy in adults (S-TOFHLA), the memory and cognition tests (ERB and ERC), and the knowledge of diabetes as a disease test (MDRTC). Once the questionnaires were completed the elder then progressed into the physical testing phase of the study which included the Jebsen-Taylor Hand Function Test, the Snellen Near Vision Testing, and the HbA1c blood sample testing. The time to complete the HbA1c testing and the set of questionnaires was anticipated to be less than 1.5 hours; however, the average time to complete the entire study was more than 2.5 hours. Subjects were required to provide a drop of their blood for the HbA1c test.

Screening & Study Instruments

The following types of data were collected on each study subject: demographic data, current HbA1c level, visual acuity level, manual dexterity level, cognition,
knowledge of diabetes, and overall health literacy level. Copies of all study instruments have been included in Appendix A. Psychometric analysis of the instruments employed in this study was not undertaken. This omission occurred because the data from the questionnaires being entered only as a total score. Most of these instruments have been reported in other studies as being reliable measures, excluding the new instruments for the finger stick blood sample technique and the demographic information.

The selection of data instruments was undertaken after review of the literature. All the instruments selected for the study had reported high levels of reliability and validity as well as having been previously utilized within elderly populations in other research studies. Health literacy instruments surveyed included the S-TOFHLA, the Rapid Estimate of Adult Literacy in Medicine (REALM), and the Wide-Range Achievement Test. The instruments compared that measure diabetes knowledge were the MDTRC, the Diabetes Knowledge Assessment (DKN), and the Diabetes Knowledge Survey for Native Americans (DKSNA). Both the S-TOFHLA and the MDRTC were selected because of their common usage in health literacy screening and diabetes education today. Selection of the instruments to test the age related developmental deficits (cognition, vision, and manual dexterity) was based on the need for the instrument to be delivered in a community setting with only the researcher gathering the data. The instruments surveyed to test visual acuity were the Snellen Near Vision Test, the Early Treatment Diabetic Retinopathy Test (ETDRT), and the Freiburg Visual Acuity
The Snellen Near Vision Test was selected because of its portability into a community setting. Manual dexterity measurements examined included the Jebsen-Taylor Test of Manual Dexterity, Manual Dexterity Test (MDT), and the Box and Block Test (BBT). Jebsen Taylor was selected for the study because of its ability to measure both fine and gross motor skills within a reasonable time frame within community test settings. The instruments surveyed to measure cognition were the Everyday Cognition Battery, the Health Utilities Index (HUI), the Clock Drawing Test (CDT), and the Cognitive Capacity Screening Examination. The Everyday Cognition Battery was chosen for this study because of its use of subscales to measure two of the components of cognition (memory and reasoning) as opposed to those scales that only included cognition as a subscale within a larger instrument.

Each subject was screened for cognition status using the Mini-Mental State Examination (MMSE) (Cockrell, & Folstein, 1988). This tool consists of a series of brief questions in five areas designed to gather information on orientation, recognition, attention/calculation, recall, and language. In various forms this test has been utilized as a test for cognition for over 30 years and it has been translated into 17 languages. Reliability of the MMSE is reported as .81 (Tombough, McDowell, Kristjanssan, & Hubley, 1996).

The demographic data form was used to gather information via a short 11-question survey developed for this study. Areas addressed included date of birth, marital status, country of origin, first language spoken, length of time with diabetes, highest
educational level achieved, prior exposure to formalized diabetes education including format, and type of health professional providing the education.

Self-care was measured by the subjects’ HbA1c levels which served as the physiological marker for recent level of self-care related to overall glycemic control. Scoring for this test is rated on a scale of 0-15%. This variable data was entered into SPSS as a number between 1-15 with two decimal points. This test has traditionally only been available through medical laboratory settings; however, recent developments in home-testing units, employed in this study, made it possible to obtain an immediate HbA1c reading on each subject. There were three reasons for utilizing this new technology: first it gave the subject an incentive to complete the survey forms, if he/she did not have access to the equipment outside of this study. Second it permitted the researcher to obtain all study data in one sitting. Third it was less costly than laboratory testing. The home-testing HbA1c that was employed in this study was produced by Metrika Inc. This method of testing HbA1c levels has been confirmed as accurate to within a 95% confidence limits–0.1%+0.1% of laboratory HbA1c levels (Cagliero, Levina, & Nathan, 1999). The recognized standard of care from the American Diabetes Association (2002) is a glycated hemoglobin reading of 7.0% correlating to a fasting blood sugar of between 120-150 mg/dl. An HbA1c score of 7% is the preferred value, scores on either side of that value indicate the presence of undesired glycemic levels. Those HbA1c values less than 6% indicate hypoglycemia states present within past three months, while scores over 8% indicate hyperglycemia occurring within the past three months. After each subject had
completed the finger stick blood draw test, under universal precautions the primary investigator placed the blood sample test strip into the HbA1c individual test units to ensure accuracy and comparability of test results across subjects.

Manual dexterity was measured using the Jebsen-Taylor Hand Function Test. Timed measurements for subjects to complete a series of tasks indicated the degree of manual dexterity possessed by the subject. The Jebsen-Taylor test required eight separate tasks (copying diagram, sorting cards, picking up small items, stacking blocks, simulated feeding, picking up light weight items, and picking up heavier weighted items) that were measured for each hand. The tasks were explained to subjects with a corresponding visual demonstration by the primary investigator. The length of time necessary for a subject to successfully complete each task with both hands was recorded. High validity across populations (Stern, 1992) and a reliability of 0.66-.99 with a mean score of 0.84 for the Jebsen-Taylor has been reported (Okkema & Culler, 1998). Manual dexterity was also measured by observing the subject’s ability to perform a successful finger-stick and a correct HbA1c test strip application. Scoring for the finger stick blood sample test was rated from 1 = requires complete assistance, 2 = needs some assistance, and 3= able to perform independently. This tool has yet to be rated for reliability and validity.

Visual acuity was measured using a standard Snellen Near Vision test. Use of the Snellen Near Vision Test has been a standard tool for over 100 years to access visual acuity (Lovie-Kitchine, & Brown, 2000; McGraw, & Winn, 1995). The reliability of the
Snellen Near Vision Test has been called into doubt recently as a tool for diagnosing vision changes over time (Whitaker & Winn, 1995); however, in this study a one time only measure of visual acuity was taken, negating this reservation on the reliability of the test. Employing a commercially produced copy of the Snellen Near Vision Test card, the research instructed the subject to hold the card at 14-inches from his/her face and then to read aloud the smallest set of letters the subject could see clearly. Vision was scored as first line repeated by subject to researcher without errors. Testing scores potentially could have ranged from 20/10 to 20/100; however, in this study the best vision reported was 20/20 and the poorest vision was documented at 20/90.

Diabetes Disease Specific Knowledge was used to measure the ability to correctly identify information related to diabetes as a chronic condition and information on diabetes self-care. The Brief Diabetes Knowledge Test was developed by Michigan Diabetes Research and Training Center to gauge the knowledge of subjects about diabetes as a condition, its potential complications, and self-care measures (Fitzgerald, et al., 1998). This test is a 23-item multiple choice questionnaire that is completed independently by the subject. This test has been previously assessed as having a reliability alpha of > 0.70 and has demonstrated validity in community and acute care settings (Fitzgerald, et al., 1998). Summing the number of correct answers was the strategy for scoring the test.

Health Literacy was defined as the subject’s ability to read and comprehend written health care information and to correctly perform numerical tasks related to their
health care. The Test for Function Health Literacy in Adults (S-TOFHLA) was used to measure the subject’s overall health literacy level. The S-TOFHLA consisted of seven fill-in-the-blank-style questions, completed independently by each subject, that gauged the individual’s ability to interpret and correctly utilize health care information. Baker, Williams, Parker, Gazmararian, and Nurss (1999) developed this shortened version of the TOFHLA for use in adult populations. The Cronbach’s alpha of the S-TOFHLA has been measured as 0.97. The S-TOFHLA is reported to have a reliability and validity similar to the full TOFHLA, but is deemed more useful because of its shorter length (from 21 items in the TOFHLA to 7 items in the S-TOFHLA). The S-TOFHLA was scored as the number of correct responses from the total number of questions in the examination.

Cognition was defined as those mental processes involving problem solving and memory that permit the individual to make rational choices between alternative options. The Everyday Cognition Battery (Inductive Reasoning and the ECB Working Memory) was used to measure cognition (Allaire, & Marsiske, 1999). The 30 item ECB Working Memory test used letters and numbers arranged in everyday information to assess the subjects’ short-term memory. After viewing the test information for brief time periods (1 minute per data set), the subject was directed to recall as many of the previously displayed items as possible within a set time frame. This test, like the Inductive Reasoning Test, was written so that the correct answers are either numerical or one to two word responses and was scored on a 3-point scale for each item. Cronbach's alpha coefficient indicated that each sub-test within the ECB was composed of a homogenous
set of test items ($\alpha = .69-.88$). Reliability for this relatively new instrument reported in the literature is restricted to testing under controlled laboratory conditions. The Inductive Reasoning test is composed of 43 items (short answer) that are completed independently by each subject. The Inductive Reasoning test includes traditional measures of letter sets and number series that are presented in a naturally occurring format. The subject is asked to look at the sets of information (prescription instructions, check book entries, food packaging information, appointment cards) and then to find a relationship or pattern within the information to solve everyday problems. Test answers were formatted by the test author to elicit simple one to two word responses. The test was scored as correct if an exact word match was present (2 points), partially correct if only one word of the two-item response was present (1 point), and incorrect if no exact word match in the answer was present (0 points) for each item.

Data Collection and Analysis

SPSS (12.0) statistical software was utilized for data analysis to predict the explanatory power of one or more of the independent variables to predict the dependent variables of diabetes knowledge and self-care management. Consultation regarding the interpretation of the data analysis was sought from the dissertation committee members and/or an independent statistician.

Nominal variables are those that sort into mutually exclusive, exhaustive collections. In ordinal variables the categories themselves can be ranked-order from
highest to lowest. Within this study the nominal/ordinal variables are attendance in diabetes educational class, gender, ethnicity, marital status, first language learned, country of origin, and ability to identify professional identify of diabetes class instructor. Statistical measures for these variables included number and percent frequency within the sample. Interval as well as ratio variables possess a common and equal unit that separates adjoining categories. Examples of interval or ratio variables in this study included age, length of formal education, length of time with diabetes, cognitions test scores (ERB and ERC), Snellen Vision Test, Jebsen-Taylor Manual Dexterity Test, Finger Stick Test, STOFHLA scores, MDRTC scores, and HbA1c results. Statistical measure for these variables included mean, frequency and standard deviation.

Following coding and data entry descriptive statistical analysis was preformed. Measures of central tendency, frequency, and standard deviations were sought for the demographic information first. The mean, range and standard deviation of the major study variables of HbA1c, STOFHLA, MDRTC, attendance in diabetes educational classes, and age related developmental deficits (cognition, vision, and manual dexterity) was also completed. Testing for normality of data distribution (assessing for the traditional bell-shaped, symmetrical, unimodal curve) and homoscedasticity (possessing equal statistical variance) occurred both statistically through employment of Pearson’s R as well as through box plots and histograms. Correlations were examined at the within stage level to assess for multicollinearity (independent variables are too closely correlated with each other to allow for clear analysis of their impact on the dependent variable) and
the degree of association between the dependent variable (HbA1c) and the independent variables. Based on the correlations any statistically significant relationships demonstrated between the study variables were then explored by regression analysis to answer the research questions and study hypotheses. Regression analysis was completed for each of the six research questions and three hypotheses identified by examining the significance of the model and the standardized beta coefficients. The unstandardized beta efficient represents the slope or rate of change in the average of the dependent variable for a one-unit increase in the unstandardized (i.e. original measurement scale) independent variable. Standardized beta coefficient represents the slope or rate of change in the average of the dependent variable for a one-unit increase in the standardized independent variable. (Kline, 1998). The independent variable is standardized so that it has a mean of 0 and a standard deviation of 1. By standardizing the independent variables, the magnitude of the absolute value of the standardized beta coefficient details information about which independent variable has the biggest impact on the dependent variable. Because unstandardized regression coefficients reflect the scales of their predictors, the values of the betas from predictors with different raw scores are not directly comparable. In standardized regression coefficients the expect increase in the rise in standard deviation units controlling for other predictors. With the standard deviations of the standardized variables are all equal to 1, the values of the beta weights can be directly compared across the predictors.
Summary Chapter 3

The methodology selected for this research study was causal modeling using regression analysis. This design allowed for examination of relationships among several independent variables and one dependent variable. Like other correlation techniques, multiple regression requires that the data be quantitative and normally distributed. A major limitation of this methodology is that while a relationship between an independent and dependent variable may be demonstrated based on the strength of their correlation, no causality may be implied except as specified by the proposed theory.
CHAPTER FOUR
RESULTS OF DATA ANALYSIS

The results of data analysis are presented in this chapter. The findings are presented in three sections: 1) a description of the sample including demographic information, diabetes health related data, and distribution of study variables; 2) the psychometric testing of study instruments; and 3) the testing of the originally proposed theoretical model and addressing the primary relationships.

STATISTICAL METHODS

Statistical analyses were carried out using SPSS for Windows (SPSS 12.0, SPSS Inc., Chicago, IL). Both descriptive and inferential statistical methods were employed. All testing was based on determining statistical significance at $p = 0.05$. Pearson correlation coefficients were employed to evaluate the linear association between continuous variables. Linear regression analysis was used to obtain coefficients for independent variables and to identify independent predictors in a multivariate model.

Description of the Sample

Eighty-eight elders participated in this study. Thirteen subjects were eliminated due to their inability to follow through with the rigors of the study protocol. Of the thirteen who did not complete, subject fatigue was cited by eleven of them and no reason for withdrawal was provided by the other four. Only the demographic characteristics of the remaining 75 elders with complete data sets are described.
The age of the sample ranged from 62 years to 94 years with a mean age of 78 years (Table 4.1). Other general characteristics of the sample: age, years of residency in the United States, years of formal education, and years living with formal diagnosis of diabetes are summarized in the following table.

Table 4.1.
Demographics Information for Elders with Type 2 Diabetes in the Study

<table>
<thead>
<tr>
<th>Variable</th>
<th>N(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>Minimum age = 62</td>
</tr>
<tr>
<td></td>
<td>Maximum age = 94</td>
</tr>
<tr>
<td>Years U.S. Residency</td>
<td></td>
</tr>
<tr>
<td>10-20</td>
<td>5 (6%)</td>
</tr>
<tr>
<td>21-30</td>
<td>6 (8%)</td>
</tr>
<tr>
<td>31-40</td>
<td>2 (2%)</td>
</tr>
<tr>
<td>41-50</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>51-60</td>
<td>2 (2%)</td>
</tr>
<tr>
<td>61-70</td>
<td>30 (40%)</td>
</tr>
<tr>
<td>71-80</td>
<td>21 (28%)</td>
</tr>
<tr>
<td>81 or greater</td>
<td>5 (6%)</td>
</tr>
<tr>
<td>Formal Education (years):</td>
<td></td>
</tr>
<tr>
<td>Less than 6</td>
<td>02 (02.7%)</td>
</tr>
<tr>
<td>7-12</td>
<td>52 (69.3%)</td>
</tr>
<tr>
<td>13 or more</td>
<td>21 (28.0%)</td>
</tr>
<tr>
<td>Years with Diabetes</td>
<td></td>
</tr>
<tr>
<td>1-2</td>
<td>05 (06.3%)</td>
</tr>
<tr>
<td>3-5</td>
<td>20 (26.7%)</td>
</tr>
<tr>
<td>6-7</td>
<td>15 (20.0%)</td>
</tr>
<tr>
<td>8-9</td>
<td>09 (12.0%)</td>
</tr>
<tr>
<td>10-11</td>
<td>09 (12.0%)</td>
</tr>
<tr>
<td>12-13</td>
<td>10 (08.3%)</td>
</tr>
<tr>
<td>14-15</td>
<td>01 (01.3%)</td>
</tr>
<tr>
<td>16 or more</td>
<td>06 (08.0%)</td>
</tr>
</tbody>
</table>

Mean age of the sample was 78 years (SD = 2.50) with average residency in the United States as 62.3 years (SD = .91). Fifty-four percent (53.9%) of the sample was female (N = 41), while forty-five percent (44.7%) was male (N =34). Most subjects were married (36.0%), with thirty percent (29.3%) reporting they were divorced or separated,
and 20.0% (N= 15) saying they were widowed. Most subjects (52.6%, N = 40), described themselves as White, non-Hispanic, another 17.3% self identified as Hispanic (N =13), and the remainder of the sample was composed of small numbers of African Americans, Asians, and Native Americans. Almost 70% of the sample (69.3%) reported having between 7 and 12 years of formal education. The level of formal education ranged from less than 6 years (N = 2) to more than 13 years (N = 21) with the average being 11.7 years (SD = 2.67). English was reported as the first language learned by 77.3% (N = 58) of the elders, and the Spanish language was the next most frequently reported as being the first language learned (13.2%, N = 10). The remaining seven elders reported first learning Tagalog or another language.

The greatest frequency (N = 20) of elders reported that they had been diagnosed with diabetes for between 3-5 years (mean = 8.06, SD = 4.44). Of the elders in the study only 18 reported receiving formal diabetes education. Of those reporting prior exposure to formal diabetes education only six were able to name the health occupation of the person who instructed them in diabetes self-care. From a listing of diabetes self-care items 35 of the elders selected the category of monitoring their food intake as the action most frequently undertaken in self-care of their diabetes.

Description of Study Variables

The study involved nine major study variables and five important demographic variables. The major study variables were: HbA1c, the measure of diabetes self care in stage 3; two stage 2 variables including health literacy (STOFHLA) and diabetes specific
knowledge (MDRTC); and the stage 1 variables of prior attendance in a diabetes education class as well as the age related developmental deficits of cognition (ERB & ERC), vision (Snellen Test of Near Visual Acuity), and manual dexterity (Jebsen-Taylor and Finger Stick Blood Draw technique). Five demographic variables were also studied as stage 1 variables including: age, gender, ethnicity, marital status, and years of formal education.

The mean, potential and actual range of data and the standard deviations of the major study variables are listed in Table 4.2. The range for HbA1c values in this study was between 7.00% and 13.44% (SD 1.94). The HbA1c level mean was 8.13% which corresponds to daily blood sugars over the prior three month period of slightly above the recommended 7.00%. The test of diabetes knowledge (MDRTC) mean score for this study was 13.86, with scores ranging from 4.00 – 20.00 (SD 4.87). The test of functional health literacy (STOFHLA) mean score was 8.25, with scores ranging from 4.00 – 10.00 (SD 1.51). The ERC test mean was a score of 11.18, with a range of scores from 4.00 to 20.00 (SD = 4.18). The ERB test score mean was 17.33 with a range from 9.00 to 40.00 (SD 7.85). The mean near vision score was 20/30 (with or without corrective lens) with a range of 20/20 to 20/90 (SD 1.90). The timed test for manual dexterity (Jebsen-Taylor) yielded a mean of 8 minutes and 12 seconds to successfully complete all tasks with a range of 2 minutes and 25 seconds to 16 minutes and 51 seconds, with a standard deviation (SD) of 3 minutes and 1 second. The finger stick blood draw technique test mean was 1.4 with a range of 1 to 3 and SD of 0.49. The largest SDs were found for
cognition (ERC & ERB) was well as for diabetes knowledge. The relatively high SD in the ERC, ERB, and MDRTC may reflect problems with the study instruments themselves, or reflect the variability of elders on these characteristics, or it may be a reflection of subject fatigue in the testing process. However, even the relatively high SDs for ERC, ERB, and MDRTC do not violate the accepted parameter of elevated SD being equal to or greater than half of the variable mean.

Distribution is a summary of the frequency of individual variables or ranges of values for variables. In a normal distribution the majority of the scores tend to cluster near the statistical mean with increasingly infrequent concentrations of scores appearing on the periphery. This pattern yields the bell-shaped curve of a normal distribution. The eight major variables in this study (age-related developmental deficits [e.g. ERB & ERC for cognition, Snellen vision test for visual acuity, and Jebsen-Taylor and Finger Stick Blood draw Technique for manual dexterity], health literacy, diabetes specific knowledge and HbA1c) all demonstrated the bell-shaped curve of a normal distribution.

Symmetry of data distribution is measured by skewness and kurtosis. If the data is perfectly symmetrical then the mean minus the median divided by the standard deviation equals zero. While none of the major study variables returned a coefficient of zero, none had values above ±1. The measure of kurtosis returned values for all major study variables indicated that study data was evenly distributed (e.g. zero indicates perfect symmetry). The assumption for a normal distribution of study data was met.
Table 4.2. Description of Study Variables.

<table>
<thead>
<tr>
<th>Study Variable</th>
<th>Potential Data Range</th>
<th>Mean</th>
<th>Actual Data Range</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snellen Near Vision Both Eyes</td>
<td>20/10-20/100</td>
<td>20/30</td>
<td>20/20 – 20/90</td>
<td>1.90</td>
</tr>
<tr>
<td>HbA1c</td>
<td>1.00-15.00</td>
<td>8.13</td>
<td>7.00 – 13.44</td>
<td>1.94</td>
</tr>
<tr>
<td>Jebsen-Taylor Hand Dexterity Total Time</td>
<td>.01-20.00</td>
<td>8.12</td>
<td>2.25 – 16.51</td>
<td>3.01</td>
</tr>
<tr>
<td>Finger Stick Blood Draw Technique</td>
<td>1.00-3.00</td>
<td>1.4</td>
<td>1.00- 3.00</td>
<td>0.49</td>
</tr>
<tr>
<td>ECB</td>
<td>1.00-30.00</td>
<td>11.18</td>
<td>4.00 – 20.00</td>
<td>4.18</td>
</tr>
<tr>
<td>ERB</td>
<td>1.00-42.00</td>
<td>27.33</td>
<td>9.00 – 40.00</td>
<td>7.85</td>
</tr>
<tr>
<td>STOFHLA</td>
<td>1.00-10.00</td>
<td>8.25</td>
<td>4.00 – 10.00</td>
<td>1.51</td>
</tr>
<tr>
<td>MDRTC</td>
<td>1.00-23.00</td>
<td>13.86</td>
<td>4.00 – 21.00</td>
<td>4.87</td>
</tr>
</tbody>
</table>

Psychometric Testing

Psychometric testing aims to establish the reliability and validity of each measurement instrument. Reliability is concerned with the precision of the instrument in an effort to minimize error relative to a true score. The ability of an instrument to measure what it purports to measure is an indication of instrument validity. In this study no psychometric retesting of the selected instruments was undertaken. A limitation of this study is the lack of knowledge about whether or not the correlations were attenuated by poor reliability. This study limitation may also have been implicated in the higher than expected SD values for the tests of cognition and diabetes knowledge tests. Coefficient alphas for instruments were not verified by the researcher because scores for study questionnaires were entered into data bases as only total scores.

Correlations

Correlations were utilized to assess two factors: (1) multicollinearity or high correlations among the within stage independent variables, and (2) the degree of
association between the independent and dependent variables as a strategy for
determining the order of variable entry in the regression analysis.

Assessment of Multicollinearity

The following paragraphs are an explanation of how each variable in the study
was coded. Table 4.3 displays the correlations of variables within stage 1.

Age was coded as the number of years since birth. Gender was coded as 1 for
females and 0 for males. The risk of diabetes is also greater among certain minority
ethnic groups such as Hispanics, Blacks, and Native Americans; therefore, ethnicity was
coded as 1 for non-white and 0 for white. The marital status variable was coded as 1 for
married and 0 for unmarried. Years of formal education was coded as the number of
years of schooling attended. Prior attendance in a formal diabetes educational class was
entered as 1 for yes and 0 for no. Scores for ERC and ERB were entered as the scores on
the measures of cognition tests. Higher scores on the cognition tests reflected better
cognitive abilities. The score for visual acuity was coded using the denominator which
ranged in values in this study from 20 to 90. Higher scores on the Snellen therefore
reflected poorer visual acuity. The Jebsen-Taylor Manual Dexterity test was entered as
the total time to complete the tasks. Lower scores on the Jebsen-Taylor reflect better
manual dexterity. Ability to perform finger stick technique was coded as independent = 3,
needs some level of assistance = 2, and requires complete assistance = 1. Higher scores in
this variable reflect better manual dexterity.
The STOFHLA and the MDRTC, both stage 2 variables, were coded as the scores obtained by the elder for each test. The stage 3 variable of HbA1c had potential testing values ranging from 1%-15%. HbA1c scores near 7% indicate ongoing, good control of glycemic levels and no one in the sample had an HbA1c value below 7%. HbA1c scores in this study ranged from 7.00% to 13.44%.

Multicollinearity occurs when within state study variables are too closely related to allow for independent interpretations of their impact on study outcomes. This condition may occur if there is a high degree of correlation between the within study variables (>0.85) or the signs for the correlations do not correspond to theorized signs (Cohen, 1977). None of the study variables demonstrated a high degree of correlation. The greatest degree of correlation among the stage 1 study variables was demonstrated between the ERB and Ability to Perform Finger Stick (r = -.60) (Table 4.3). The cognition variable of ECB displayed relationships to ERB (r = .53), Snellen Visual Acuity (r = -.57) and Jebsen-Taylor Manual Dexterity (r = -.55). A moderately strong correlation was noted between ethnicity and years of formal education (r = .49). All study variables within stage 1 demonstrated correlation values ranging from r = 0.01 to r = 0.60. None of the entered variables returned a perfect zero value, but the majority of r-values were between 0.30 and 0.50 indicating there was sufficient unique variation among the variables. In this study none of the variables returned correlational values approaching the 0.85 value that would indicate high correlation as a factor for multicollinearity as a study limitation.
Table 4.3. Correlations of Within Stage 1 Study Variables (N= 75)

<table>
<thead>
<tr>
<th></th>
<th>AGE</th>
<th>SEX</th>
<th>ETH</th>
<th>MS</th>
<th>ED</th>
<th>DE</th>
<th>ECB</th>
<th>ERB</th>
<th>VA</th>
<th>DEX</th>
<th>FS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender (SEX)</td>
<td>-11</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethnicity (ETH)</td>
<td>.06</td>
<td>-.04</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marital Status (MS)</td>
<td>-.11</td>
<td>.20</td>
<td>.14</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Years of Formal Education (ED)</td>
<td>.02</td>
<td>.02</td>
<td>.49**</td>
<td>.08</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attendance at DM Education (DE)</td>
<td>.07</td>
<td>-.08</td>
<td>.00</td>
<td>.01</td>
<td>.33**</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ECB</td>
<td>-.01</td>
<td>.00</td>
<td>.14</td>
<td>.39**</td>
<td>.02</td>
<td>-.23*</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ERB</td>
<td>.04</td>
<td>-.11</td>
<td>.45**</td>
<td>.19</td>
<td>.33**</td>
<td>-.20</td>
<td>.53**</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Snellen Test for Visual Acuity (VA)</td>
<td>-.09</td>
<td>.03</td>
<td>.02</td>
<td>-.02</td>
<td>.03</td>
<td>-.14</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jebsen-Taylor Manual Dexterity (DEX)</td>
<td>-</td>
<td>-.31**</td>
<td>.18</td>
<td>.20</td>
<td>-.27*</td>
<td>.14</td>
<td>-.55**</td>
<td>.20</td>
<td>.56**</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Perform Finger Stick (FS)</td>
<td>.15</td>
<td>-.05</td>
<td>-.21</td>
<td>-.22</td>
<td>-.28*</td>
<td>.17</td>
<td>-.40**</td>
<td>.22</td>
<td>.21</td>
<td>1.00</td>
<td></td>
</tr>
</tbody>
</table>

*<.05  **<.01

The Correlations between within stage 2 variables (STOFHLA and MDRTC) were also examined. These two variables returned evidence of a relationship between them (r=.42) at the .05 level.
Table 4.4. Correlations of Within Stage 2 Study Variables (N= 75)

<table>
<thead>
<tr>
<th></th>
<th>SOFHLA</th>
<th>MDRTC</th>
</tr>
</thead>
<tbody>
<tr>
<td>STOFHLA</td>
<td></td>
<td>1.00</td>
</tr>
<tr>
<td>MDRTC</td>
<td>.42**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.00</td>
<td></td>
</tr>
</tbody>
</table>

*<0.05  
**<0.01

Association between Independent and Dependent Variables

Table 4.5 illustrates the correlations between the independent and dependent study variables.

Table 4.5. Correlations of Hypothesized Predictor Variables to HbA1c. (N= 75)

<table>
<thead>
<tr>
<th></th>
<th>HbA1c</th>
<th>VA</th>
<th>FS</th>
<th>MD</th>
<th>ECB</th>
<th>ERB</th>
<th>STOFHLA</th>
<th>MDRTC</th>
</tr>
</thead>
<tbody>
<tr>
<td>HbA1c</td>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Snellen Test of Visual Acuity (VA)</td>
<td></td>
<td>- .22</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finger Stick (FS)</td>
<td></td>
<td>.39**</td>
<td>.22</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jebsen-Taylor Manual Dexterity (MD)</td>
<td></td>
<td>.05</td>
<td>.56**</td>
<td>21</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ECB</td>
<td></td>
<td>-.14</td>
<td>-.53**</td>
<td>-.40**</td>
<td>-.55**</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ERB</td>
<td></td>
<td>-.64**</td>
<td>.14</td>
<td>-.60**</td>
<td>-.20</td>
<td>.53**</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>STOFHLA</td>
<td></td>
<td>-.52**</td>
<td>.00</td>
<td>-.22</td>
<td>-.00</td>
<td>-.28*</td>
<td>.57**</td>
<td>1.00</td>
</tr>
<tr>
<td>MDRTC</td>
<td></td>
<td>-.30**</td>
<td>-.34**</td>
<td>-.28</td>
<td>-.36**</td>
<td>.60**</td>
<td>.47**</td>
<td>.42**</td>
</tr>
</tbody>
</table>

*<0.05  
**<0.01

Moderately strong and statistically significant correlations (r= .52 and .64) were noted between the measure of diabetes self care (HbA1c) and the variables of STOFHLA and ERB. The ERB demonstrated a significant correlation (r = -0.64) to HbA1c at the 0.05.
level. Those with higher test scores for reasoning ability had lower HbA1c levels or better diabetes self care. The correlation between the Shortened Test of Functional Health Literacy in Adults (STOFHLA) and HbA1c was -0.52. Elders who scored higher on the health literacy test demonstrated lower HbA1c levels or better diabetes self care. There were also statistically significant, but slightly weaker relationships demonstrated between the Ability to Perform Finger Stick Technique and HbA1c ($r = .39$). Individuals who could successfully perform a finger stick blood draw tended to have higher HbA1c levels or worse diabetes self care. A significant correlation between the scores on the Michigan Diabetes Research and Training Center’s Test of Diabetes Specific Knowledge (MDRTC) ($r = -.30$) and HbA1c levels was also observed. Higher scores on the test of diabetes knowledge correlated to lower HbA1c scores or better diabetes self care.

Table 4.6 reports the relationships between the first stage demographic variables (gender, age, marital status, ethnicity, years of education) themselves, attendance in a diabetes educational class, and the second stage variable of health literacy. Significant correlations were seen between ethnicity and years of education ($r = .49$). Ethnicity and health literacy ($r = .42$) were significantly correlated. Higher health literacy scores were associated with the subject being non-white, and with the subject having more years of formal education. Attendance in a diabetes education class had a weaker relationship with years of education ($r = .33$). Elders who had more formal education also reported attending diabetes educational classes.
Table 4.6. Correlations: Basic Conditioning Factors and Health Literacy. (N= 75)

<table>
<thead>
<tr>
<th></th>
<th>SEX</th>
<th>AGE</th>
<th>MS</th>
<th>ETH</th>
<th>ED</th>
<th>DE</th>
<th>STOFHLA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender (SEX)</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>-.11</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marital Status (MS)</td>
<td>.20</td>
<td>-.11</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethnicity (ETH)</td>
<td>-.04</td>
<td>.06</td>
<td>.14</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Years of Formal Education (ED)</td>
<td>.02</td>
<td>.02</td>
<td>.08</td>
<td>.49**</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attended Diabetes Education Class (DE)</td>
<td>-.08</td>
<td>.07</td>
<td>.01</td>
<td>.00</td>
<td>.33**</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>STOFHLA</td>
<td>-.18</td>
<td>.15</td>
<td>.02</td>
<td>.42**</td>
<td>.59**</td>
<td>.15</td>
<td>1.00</td>
</tr>
</tbody>
</table>

*<0.05  
**<0.01

The relationships of a first stage variable (attended diabetes educational class) and a second stage variable (MDTRC) was demonstrated to have a slight but significant relationship (r= -27). An elder who had previously attended a diabetes education class scored lower on the test of diabetes knowledge. A finding opposite of what was theorized.

The correlations between the two stage 2 variables of STOFHLA and MDRTC and the stage 3 variable (HbA1c) were also examined. Both the scores for the health literacy (r = -0.52) and diabetes specific knowledge (r =-0.30) were statistically significant and negatively correlated to HbA1c levels. Those with HbA1c readings near 7% had higher levels of health literacy and knowledge of diabetes as a disease state. These findings agreed with theorized relationships.
The correlations indicated that there were statistically significant relationships demonstrated between the study variables. The strongest associations for within stage variables were between the following pairs: ERB and Perform Finger Stick; ECB and ERB; ethnicity and years of formal education, and STOFHLA and MDRTC. There were moderately strong associations found between the dependent variable of HbA1c and the independent variables of ERB and STOFHLA. Based on the correlation data the study continued to the next phase of answering the proposed research questions.

Results of Research Questions

All research questions and study hypotheses grew out of the theorized model. Each of the research questions and study hypotheses were analyzed using forward regression with all variables entered in a block. Each regression analysis was conducted for r-square, adjusted r-square, F test, and beta weights. The value for r-square represent the measure of how well the regression line fits the data points (an r-squared of 1.0 indicates a perfect fit). Adjusted r-square is based on the residual degrees of freedom and is the best indicator of fit quality when additional coefficients are added to the model (values closest to 1 indicate a better fit). While the F is used to test joint hypotheses, simultaneously testing several hypotheses involving the coefficients examining the significance of the model as a whole. Comparison between standardized beta weights of different predictors is possible because of their association to the standard deviation. This allows for the weighted judgment about which factors has the most impact on the dependent variable.
Research Question One: What is the impact of age-related deficits on diabetes self-care among elders with type 2 diabetes?

The variables tested to answer this research question were ECB, ERB, Snellen Test of Visual Acuity, Ability to Perform Finger Stick, and Jebsen-Taylor Test of Manual Dexterity, and HbA1c. Table 4.7 shows that there were two significant predictors: ERB (b= -.705) and Snellen Test of Visual Acuity (b= -.3576). Better diabetes self care was predicted by higher reasoning ability and better vision. The model as a whole demonstrated statistical significance ($r^2 = .549$, adjusted $r^2 = .516$, $F=16.81$). Over half of the explained variance (54%) in the model was attributed to relationships between the variables, with an unexplained variance of 46%. The r-squared value was 0.549, which means that ERB and Snellen Vision Test together explained approximately 54% of the total variation in HbA1c (Table 4.8). From the figures in Table 4.7 the linear regression model for HbA1c can be extrapolated as $HbA1C = 11.80 + (-0.705*ERB) + (-0.356*Snellen)$. Therefore, the average HbA1c is expected to decrease by 0.705 units for every one-unit increase in the ERB test score. A decrease of one unit in HbA1c scores will result from a decrease of 0.356 units in the Snellen score.
Table 4.7. Coefficients of Developmental Age-Related Deficits.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>11.801</td>
<td>-</td>
<td>.000</td>
</tr>
<tr>
<td>ECB</td>
<td>-.084</td>
<td>.181</td>
<td>.141</td>
</tr>
<tr>
<td>ERB</td>
<td>-.174</td>
<td>-.705</td>
<td>.000</td>
</tr>
<tr>
<td>Snellen Visual Acuity</td>
<td>-.357</td>
<td>-.356</td>
<td>.001</td>
</tr>
<tr>
<td>Successfully Obtains Finder Stick</td>
<td>.307</td>
<td>.079</td>
<td>.448</td>
</tr>
<tr>
<td>Jebsen-Taylor Manual Dexterity</td>
<td>.121</td>
<td>.189</td>
<td>.078</td>
</tr>
</tbody>
</table>

Table 4.8. Summary: Developmental Age-Related Deficits.

<table>
<thead>
<tr>
<th>R</th>
<th>R Square</th>
<th>Adjusted R square</th>
<th>Std. Error of the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>.741</td>
<td>.549</td>
<td>.516</td>
<td>1.35047</td>
</tr>
</tbody>
</table>

Research Question Two: What is the impact of basic conditioning factors on health literacy among elders with type 2 diabetes?

The variables tested to answer this research question were health literacy, age, gender, marital status, ethnicity, and years of formal education. Table 4.9 illustrates the linear regression model of Health Literacy versus Basic Conditioning Factors. There was a relationship demonstrated between gender and health literacy, $b = -.18$ There was a stronger relationship between health literacy and years of formal education, $b = .52$ (Table 4.9). Better health literacy was predicted by more formal education and by being female. The explained variance for these variables was 42% with an unexplained variance of 58%, or almost 60% of the residual variance could not be attributed to any relationship between the variables. The model as a whole was statistically significant.
(r² = .427, adjusted r² = .385, F= 10.27). The regression equation for gender and years of formal education is: STOFHLA = 3.60 + (-0.18*Gender) + (0.52*Formal Education). Therefore, the average STOFHLA score is expected to decrease by 0.18 units for every one-unit increase in gender. While the average STOFHLA score is expected to increase by 0.52 units for every one-unit increase in Years of Formal Education.

Table 4.9. Coefficients of Basic Conditioning Factors and Health Literacy.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. error</td>
<td>Beta</td>
</tr>
<tr>
<td>Constant (Health Literacy)</td>
<td>-3.60</td>
<td>7.24</td>
<td>-</td>
</tr>
<tr>
<td>gender</td>
<td>-.54</td>
<td>.285</td>
<td>-.18</td>
</tr>
<tr>
<td>age</td>
<td>.00</td>
<td>.00</td>
<td>.11</td>
</tr>
<tr>
<td>marital status</td>
<td>.014</td>
<td>.147</td>
<td>.00</td>
</tr>
<tr>
<td>ethnicity</td>
<td>.149</td>
<td>.105</td>
<td>.15</td>
</tr>
<tr>
<td>years of formal education</td>
<td>.29</td>
<td>.06</td>
<td>.52</td>
</tr>
</tbody>
</table>

Table 4.10. Summary: Basic Conditioning Factors.

<table>
<thead>
<tr>
<th>R</th>
<th>R Square</th>
<th>Adjusted R square</th>
<th>Std. Error of the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>.653</td>
<td>.427</td>
<td>.385</td>
<td>1.18898</td>
</tr>
</tbody>
</table>

Research Question Three: What is the impact of exposure to structured diabetes education on health literacy among elders with type 2 diabetes?

The variables tested to answer this research question were attendance in diabetes education class and health literacy. There was a relationship demonstrated between attendance in diabetes educational program and health literacy, b = 0.155, but the relationship was not statistically significant (Table 4.11). The explained variance for these variables was not statistically significant. With an r-squared of .024, only 2% of the total variance in health literacy could be accounted for by attendance at a diabetes education class (Table 4.12).
Table 4.11. Coefficients of Prior Exposure to Diabetes Education and Health Literacy.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant (health literacy)</td>
<td>7.489</td>
<td>.595</td>
<td>-</td>
</tr>
<tr>
<td>Prior Attendance at Diabetes Educational Classes</td>
<td>.478</td>
<td>.356</td>
<td>.155</td>
</tr>
</tbody>
</table>

Table 4.12. Summary: Prior Exposure to Diabetes Education and Health Literacy.

<table>
<thead>
<tr>
<th>R</th>
<th>R Square</th>
<th>Adjusted R square</th>
<th>Std. Error of the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>.155</td>
<td>.024</td>
<td>.011</td>
<td>1.50832</td>
</tr>
</tbody>
</table>

Research Question Four: What is the impact of exposure to structured diabetes education on disease specific knowledge among elders with type 2 diabetes?

The variables tested to answer this research question were attendance at diabetes educational classes and knowledge of diabetes. Tables 4.13-4.14 shows that attendance at diabetes education classes had a significant relationship to higher diabetes knowledge scores (b =-.270). The model as a whole demonstrates the significance ($r^2 = .073$, adjusted $r^2 = .060$, F=5.73). Table 4.13 shows that the standardized beta coefficient for “diabetes class attendance” was b= -.270. Therefore, the model of disease specific knowledge versus attendance in diabetes education class is: Knowledge = 18.1 – .270*Attend Diabetes Education Class. Thus, the average knowledge score is expected to decrease by .270 points for those who did not attend the class compared to those who did attend.
Table 4.13. Coefficients for Prior Diabetes Educational Classes on Diabetes Specific Knowledge.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant (Diabetes Specific Knowledge)</td>
<td>18.133</td>
<td>1.863</td>
<td>-</td>
</tr>
<tr>
<td>Prior Attendance at Diabetes Educational Classes</td>
<td>-2.667</td>
<td>1.113</td>
<td>-.270</td>
</tr>
</tbody>
</table>

Table 4.14. Summary: Prior Diabetes Educational Classes on Diabetes Specific Knowledge.

<table>
<thead>
<tr>
<th>R</th>
<th>R Square</th>
<th>Adjusted R square</th>
<th>Std. Error of the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>.270</td>
<td>.073</td>
<td>.060</td>
<td>4.72340</td>
</tr>
</tbody>
</table>

Research Question Five: What is the impact of health literacy on diabetes self-care among elders with type 2 diabetes?

The variables tested to answer this research question were health literacy and HbA1c. There was a statistically significant, moderately strong negative association between HbA1c and Health literacy. Table 4.15 shows that the standardized beta for health literacy was -.526. The model as a whole was statistically significant ($r^2 = .276$, adjusted $r^2 = .267$, F=27.89). The r-square value was 0.276, which means health literacy explained approximately 27% of the total variation in HbA1c (Table 4.16). Higher health literacy scores predicted better diabetes self care. The model of HbA1c versus health literacy is: HbA1c = 13.7 -0.526*(health literacy). Thus, the average HbA1c is expected to decrease by 0.526 points for each one-unit increase in Health Literacy.
Table 4.15. Coefficients of Health Literacy & HbA1c.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. error</td>
<td>Beta</td>
</tr>
<tr>
<td>Constant (HbA1c)</td>
<td>13.693</td>
<td>1.070</td>
<td>-</td>
</tr>
<tr>
<td>Health Literacy (STOFHLA)</td>
<td>-.673</td>
<td>.127</td>
<td>-.526</td>
</tr>
</tbody>
</table>

Table 4.16. Summary: Health Literacy & HbA1c.

<table>
<thead>
<tr>
<th>R</th>
<th>R Square</th>
<th>Adjusted R square</th>
<th>Std. Error of the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>.526</td>
<td>.276</td>
<td>.267</td>
<td>1.66321</td>
</tr>
</tbody>
</table>

Research Question Six: What is the impact of health literacy on disease/diabetes specific knowledge among elders with type 2 diabetes?

The variables tested to answer this question were health literacy and diabetes specific knowledge. There was a statistically significant positive association between health literacy and diabetes specific knowledge. Table 4.17 demonstrated the standardized beta for health literacy at .425. The model as a whole was statistically significant ($r^2 = .181$, adjusted $r^2 = .170$, F=16.11). The r-square value was 0.181, which means health literacy explained approximately 18% of the total variation in diabetes specific knowledge (Table 4.18). Higher health literacy scores predicted higher diabetes specific knowledge. The model of health literacy versus diabetes specific knowledge is: $MDRTC = 2.590 -0.425*(health\ literacy)$. Thus, the average scores for diabetes specific knowledge is expected to increase by 0.425 points for each one-unit increase in Health Literacy.
Table 4.17. Coefficients of Health Literacy on Diabetes Specific Knowledge.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. error</td>
<td>Beta</td>
</tr>
<tr>
<td>Constant (MDRTC)</td>
<td>2.590</td>
<td>2.855</td>
<td>-</td>
</tr>
<tr>
<td>Short Test of Functional Health Literacy in Adults (STOFHLA)</td>
<td>1.366</td>
<td>.340</td>
<td>.425</td>
</tr>
</tbody>
</table>

Table 4.18. Summary: Health Literacy on Diabetes Specific Knowledge.

<table>
<thead>
<tr>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>.425</td>
<td>.181</td>
<td>.170</td>
<td>4.439</td>
</tr>
</tbody>
</table>

Research Question Seven: What is the impact of disease/diabetes specific knowledge on diabetes self care among elders with type 2 diabetes?

The variables tested to answer this research question were diabetes specific knowledge and HbA1c. There was a statistically significant, moderate relationship between diabetes disease knowledge and HbA1c with b = -.302 (Table 4.19). More diabetes specific knowledge predicted better diabetes self care. The model as a whole was statistically significant (r² = .091, adjusted r² = .079, F= 7.13). The explained variance for these variables was only 9% with an unexplained variance of 92%. Or nearly all of the residual variance could not be attributed to any relationship between the variables. The model of diabetes disease knowledge versus HbA1c is: HbA1c = 9.8 - 0.302*(Diabetes Disease Knowledge). Thus, the average score for diabetes disease knowledge is expected to decrease by 0.302 points for each one-unit decrease in HbA1c standardized.
Table 4.19. Coefficients of Diabetes Specific Knowledge on HbA1c.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. error</td>
<td>Beta</td>
</tr>
<tr>
<td>Constant (HbA1c)</td>
<td>9.803</td>
<td>.653</td>
<td>-</td>
</tr>
<tr>
<td>Diabetes Specific Knowledge (MDRTC)</td>
<td>-.120</td>
<td>.044</td>
<td>-.302</td>
</tr>
</tbody>
</table>

Table 4.20. Summary: Diabetes Specific Knowledge on HbA1c.

<table>
<thead>
<tr>
<th>R</th>
<th>R Square</th>
<th>Adjusted R square</th>
<th>Std. Error of the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>.302</td>
<td>.091</td>
<td>.079</td>
<td>1.86412</td>
</tr>
</tbody>
</table>

Analysis of Originally Proposed Theoretical Model

This study was designed to test a theoretical model (Figure 2) of diabetes self-care in elders. The model hypothesized (1) the impact of age-related deficits in cognition (ERC & ERB); vision (Snellen Test of Visual Acuity); manual dexterity (Jebsen-Taylor Test of Manual Dexterity and Ability to Perform Finger Stick); Health Literacy, and Diabetes Specific Knowledge on Diabetes Self Care; (2) the impact of basic condition factors and attendance at Diabetes Educational Classes on Health Literacy (STOFHLA); and (3) the impact of exposure to structured diabetic education to the acquisition of disease specific knowledge (MDRTC). The basic condition factors consisted of five demographic variables: age, gender, marital status, ethnicity, and years of formal education. Each one of the three hypothesized model relationships was tested utilizing forward stepwise regression with the variables entered within each regression scenario as a grouping.
Figure 2.
Proposed Theoretical Model of Factors Impacting Diabetes Self-Care in Elders

Stage 1

Developmental Deficits/ Age Related Deficits

- Cognition (-)
  ECB
  ERB (-)
- Visual acuity (Snellen) (+)
- Manual Dexterity
  Finger Stick test (-)
  Jebsen-Taylor Test (+)

Stage 2

Social Factor
*Basic Conditioning (- & +)
Factors (Demographics)

Personal Factor
*Attend Diabetes Education Classes

Personal Factor
Health Literacy (-)
*STOFHLA (+)

Stage 3

Diabetes Self Care
* HbA1c level

Model Hypothesis One: Age Related Deficits, Health Literacy, and Diabetes Specific Knowledge Impact Diabetes Self Care

The model predicts that the dependent variable, diabetes self care as measured by HbA1c levels, was predicted by seven variables: diabetes specific knowledge, health literacy, attendance in diabetes education classes, cognition, visual acuity, manual dexterity, and basic conditioning factors. Lower HbA1c levels were predicted to be associated with higher scores on the measures of cognition, higher visual acuity scores (low recorded scores for test itself), better manual dexterity (high scores on Perform...
Finger Stick Technique [more independence] and Jebsen-Taylor [faster rate]), as well as higher testing scores for health literacy and diabetes specific knowledge.

Tables 4.21-4.22 summarize the regression for testing this hypothesis. The model was significant, $F = 14.06$, $P > 0.05$ (Table 4.21). The R square was 0.595 with an adjusted R-square of 0.553 (Table 4.22). Almost 60% of variance in HbA1c levels was explained by the variables. There were three significant relationships in the predicted directions demonstrated between the independent variables (ERB, Snellen Visual Acuity, and STOFHLA) and HbA1c (Table 4.21). The remaining variables (ERC, Perform Finger Stick, Jebsen-Taylor and MDRTC) did not contribute to the explained variance.

Table 4.21. Coefficients for Model Hypothesis #1

<table>
<thead>
<tr>
<th>Variables</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. error</td>
<td>Beta</td>
</tr>
<tr>
<td>HbA1c (Constant)</td>
<td>12.788</td>
<td>1.363</td>
<td>-</td>
</tr>
<tr>
<td>ERC</td>
<td>.114</td>
<td>.058</td>
<td>.246</td>
</tr>
<tr>
<td>ERB</td>
<td>-.129</td>
<td>.032</td>
<td>-.526</td>
</tr>
<tr>
<td>Snellen Visual Acuity</td>
<td>.360</td>
<td>.102</td>
<td>.360</td>
</tr>
<tr>
<td>Perform Finger Stick</td>
<td>.512</td>
<td>.394</td>
<td>.130</td>
</tr>
<tr>
<td>STOFHLA</td>
<td>-.279</td>
<td>.130</td>
<td>-.217</td>
</tr>
<tr>
<td>MDRTC</td>
<td>-.047</td>
<td>.042</td>
<td>-.117</td>
</tr>
</tbody>
</table>

Table 4.22. Summary of Model Hypothesis #1.

<table>
<thead>
<tr>
<th>R</th>
<th>R Square</th>
<th>Adjusted R square</th>
<th>Std. Error of the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>.771</td>
<td>.595</td>
<td>.553</td>
<td>1.29874</td>
</tr>
</tbody>
</table>
Model Hypothesis Two: Basic Condition Factors and Attendance at Diabetes Educational Classes Impacts Health Literacy.

The variables tested for a relationship to health literacy (STOFHLA) were the basic conditioning factors of age, gender, marital status, ethnicity, years of education, and attendance in a diabetes education class. Tables 4.23-4.24 summarize the regression for testing this hypothesis. The model was significant, $F = 23.58$, $P > 0.05$, $p = 0.00$ (Table 4.23). The adjusted R squares was 0.300. Approximately 30% variance in health literacy was explained by the variables. There was one significant relationship in the theorized direction demonstrated between the independent variable (years of education) and STOFHLA with a standardized beta of .548 (Table 4.23). The remaining variables (gender, ethnicity, attendance in diabetes education classes, age, and marital status) did not contribute to the explained variance.

Table 4.23. Coefficients for Model Hypothesis #2

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. error</td>
<td>Beta</td>
</tr>
<tr>
<td>STOFHLA (constant)</td>
<td>-.726</td>
<td>7.286</td>
<td>-</td>
</tr>
<tr>
<td>DOB</td>
<td>.000</td>
<td>.000</td>
<td>.115</td>
</tr>
<tr>
<td>Gender</td>
<td>-.567</td>
<td>.288</td>
<td>-.187</td>
</tr>
<tr>
<td>Martial Status</td>
<td>.018</td>
<td>.148</td>
<td>.011</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>.136</td>
<td>.108</td>
<td>.138</td>
</tr>
<tr>
<td>Years of Education</td>
<td>.311</td>
<td>.065</td>
<td>.548</td>
</tr>
<tr>
<td>Attend DM Class</td>
<td>-.166</td>
<td>.309</td>
<td>-.054</td>
</tr>
</tbody>
</table>

Table 4.24. Summary of Model Hypothesis #2.

<table>
<thead>
<tr>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>.548</td>
<td>.302</td>
<td>.300</td>
<td>1.19507</td>
</tr>
</tbody>
</table>
Model Hypothesis Three: Attendance at Diabetes Educational Classes Impacts Diabetes Disease Specific Knowledge.

The variables tested were attendance at diabetes educational classes and diabetes disease specific knowledge. The model depicts a negative association between attendance in a diabetes education class and diabetes disease specific knowledge or attending a diabetes education class. The model was significant, $F = 5.737$, $P > 0.05$, $p = 0.01$. The $R$ squared was .073 with adjusted $R$ squared was 0.060. Approximately 7% variance in Diabetes Specific Knowledge levels was explained by the one variable. There was one significant relationship in the theorized direction demonstrated between the independent variable (attendance in diabetes educational classes) and Diabetes Disease Specific Knowledge with a standardized beta of -.270 (Table 4.25).

Table 4.25. Coefficients for Model Hypothesis #3

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. error</td>
<td>Beta</td>
</tr>
<tr>
<td>MDRTC (constant)</td>
<td>18.133</td>
<td>1.863</td>
<td></td>
</tr>
<tr>
<td>Attend DM Class</td>
<td>-2.667</td>
<td>1.113</td>
<td></td>
</tr>
</tbody>
</table>

Table 4.26. Summary of Model Hypothesis #3.

<table>
<thead>
<tr>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>.270</td>
<td>.073</td>
<td>.060</td>
<td>4.72340</td>
</tr>
</tbody>
</table>

Discussion of Theoretical Model of Factors Impacting Diabetes Self-Care in Elders with Betas and Paths Indicated

Figure 3 illustrates the pathways, both retained and non-significant, along with beta weights for the theorized model. The betas depicted in the model were taken from
the three hypothesis regressions. Any variables with non-significant relationships demonstrated in the regressions of the three hypotheses were eliminated from further analysis. After regression analysis of the three hypotheses, the theorized model was left with three independent variables (ERB, Visual Acuity, and Health Literacy) that impacted directly on the dependent variable of diabetes self-care (HbA1c). The only basic conditioning factor variable that impacted on the intermediate variable of health literacy was years of education. While attending a diabetes educational class did impact diabetes specific knowledge it was not in the predicted direction. There was no statistically significant relationship demonstrated between diabetes specific knowledge and HbA1c levels.
Figure 3. Theoretical Model of Factors Impacting Diabetes Self-Care in Elders with Betas and Paths Indicated.

Developmental Deficits/ Age Related Deficits
- Cognition
  - ECB
  - ERB $\beta = -0.526$
- Visual acuity (Snellen) $\beta = 0.360$
- Manual Dexterity
  - Finger Stick test
- Jebsen-Taylor Test $\beta = -0.217$

Diabetes Self Care
- HbA1c level $R^2 = 0.595$

Social Factor
*Basic Conditioning Factors (Demographics)
- Age
- Gender
- Martial Status
- Ethnicity $\beta = 0.548$
- Years Educations $\beta = 0.270$

Personal Factors
- Health Literacy
  - *STOFHLA $R^2 = 0.302$
- Diabetes Specific Knowledge
  - *MDRTC $R^2 = 0.073$

Personal Factor
*Attend Diabetes Education Classes

Summary Chapter 4

A theoretical model was devised from the literature hypothesizing factors that impact diabetes self care in elders. Age related deficits in cognition, vision, and manual dexterity were theorized to negatively impact diabetes self care. Increased abilities in health literacy and specific knowledge of diabetes as a disease were also expected to positively impact diabetes self care. Basic conditioning factors (demographic variables) were posited to impact the health literacy of individual elders.
Correlations among the variables were explored to identify potential problems with multicollinearity; none were found. To answer the six research questions and three study hypotheses forward regression analysis was applied to the collected data. The final model contained three variables (cognitive reasoning [ERB], visual acuity [Snellen], and health literacy [STOFHLA]) that directly impacted the dependent variable (diabetes self care [HbA1c]) while accounting for an acceptable percentage of the variation in diabetes self care.
CHAPTER FIVE

DISCUSSION

Chapter five presents a discussion of the results of the research within the context of the literature and Orem’s Theory of Self Care. The evidence and conclusions for each of the study research questions and model hypotheses are contended. The implications for nursing practice, limitations of this study as well as proposals for further research are also presented.

Results of Study Research Questions and Model Hypotheses

Study data statistical significance was set at a two-sided alpha level of 0.05. Pearson correlation coefficients were utilized to evaluate the linear association between the variables. Two-sample t-tests compared the distribution of continuous variables between two levels of categorical variables. ANOVA testing was done to compare the distribution of continuous scaled variables between more than two levels of categorical variables. Linear regression analysis obtained coefficients for independent variables and identified independent predictors in the multivariate model. The findings related to each research question are summarized in Table 5.1.
Table 5.1.

Summary of Research Questions and Findings

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Summary of Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Question 1: What is the impact of age-related deficits on diabetes self-care among elders with type 2 diabetes?</td>
<td>ERB scores and visual acuity among the age related deficits had a statistically significant impact on HbA1c levels. Visual acuity did not prove to be statistically significant to diabetes self-care.</td>
</tr>
<tr>
<td>Research Question 2: What is the impact of basic conditioning factors on health literacy among elders with type 2 diabetes?</td>
<td>A participant’s years of formal education of the basic conditioning factors had the strongest effect on health literacy scores. The data demonstrated an unexpected relationship between health literacy and those who reported an ethnicity as non-white.</td>
</tr>
<tr>
<td>Research Question 3: What is the impact of exposure to structured diabetes education on health literacy among elders with type 2 diabetes?</td>
<td>Prior exposure to a diabetes educational class had a slight but significant impact on health literacy scores.</td>
</tr>
<tr>
<td>Research Question 4: What is the impact of exposure to structured diabetes education on disease specific knowledge among elders with type 2 diabetes?</td>
<td>Attendance in a diabetes educational class had an opposite impact on participants’ disease specific knowledge scores about diabetes than was expected.</td>
</tr>
<tr>
<td>Research Question 5: What is the impact of health literacy on diabetes self-care among elders with type 2 diabetes?</td>
<td>Lower health literacy scores had a significant impact on increased HbA1c scores or worse diabetes self care.</td>
</tr>
<tr>
<td>Research Question 6: What is the impact of health literacy on disease/diabetes specific knowledge among elders with type 2 diabetes?</td>
<td>Low health literacy score decreases had a significant impact on disease specific knowable about diabetes scores.</td>
</tr>
<tr>
<td>Research Question 7: What is the impact of diabetes specific knowledge on diabetes self care among elders with type 2 diabetes?</td>
<td>Diabetes specific knowledge did not impact diabetes self care levels.</td>
</tr>
</tbody>
</table>

**Research Question One.**

What is the impact of age related deficits on diabetes self-care among elders with type 2 diabetes?

Age related developmental deficits were composed of three sub-factors: altered cognition, decreased visual acuity, and decreased manual dexterity. While it was expected that decreases in vision and manual dexterity would considerably affect the ability of the elderly person with diabetes to maintain a lower HbA1c level (have better diabetes self-care), the amount of variance in HbA1c scores explained by these variables
was small. The cognitive factor of reasoning as demonstrated by the scores on the Everyday Reasoning Battery (ERB) had the most impact on the level of diabetes self-care ($\beta = -.705$). The beta score for the Snellen test was -.356.

The literature reviewed for this study evidenced that while diabetes is the topic of many studies, little research has been done to examine the impact of alterations within individuals’ physical or mental capacities on diabetes self-care. Most research studies about the relationship of diabetes between physical and mental capabilities have been designed to examining how diabetes as a condition alters individuals’ physical or mental abilities. For example, Linderman, et al. (2001) found no supporting evidence for the position that elders with type 2 diabetes were at a greater risk for development of cognitive impairment. In 2003, however, Coker and Scumaker did find evidence that those with type 2 diabetes performed more poorly on at least one neurophysiological test of cognition, indicating that there might be a link between decreasing cognitive skills and diabetes. In this study, cognitive measures for memory and reasoning ability were examined, while an elder’s ability to reason was shown to have a statistically significant impact on the scores for diabetes self-care. This relationship was not evidence for memory and HbA1c levels. Self care for people with diabetes involves problem solving on many levels from nutrition, to exercise, to symptom identification, and medication management. Elders with poor reasoning capabilities will have greater difficulties with diabetes self care.
The literature documents few research studies related to the impact of diabetes on vision; however, there are no research studies present within the literature that address the issue of how visual acuity impacts HbA1c scores. Bernbaum, et al. (2000) as well as Umeh, Wallhagen, and Nicoloff (1999) conducted research that examined how an educational intervention among those with decreased vision positively affected diabetes foot care. In this study the variable of visual acuity did not prove to be statistically significant predictor of diabetes self-care. Many of today’s diabetes educational programs possess curricula heavily invested in visual methodology.

The last age related developmental deficient examined within the literature and this study was manual dexterity. Once more the literature has a few studies that speak to the impact of diabetes on peripheral nerve conduction and by extrapolation manual dexterity. There were no studies evident within the literature that dealt with how manual dexterity impacts diabetes self-care. The Diabetes Complication and Control Trial (1995) demonstrated that significant nerve conduction differences were present in those persons participating over the five years of the study. Maser, Laudodio, and DeCherney (1993) preformed a study to evaluate the association between age and vibratory thresholds in those persons over age 45 with and without a diagnosis of diabetes. The result of the exploratory study was that persons with diabetes were shown to have greater incidences of nerve compromise than those without diabetes. However, in this research study, manual dexterity did not significantly impact diabetes self care.
Orem’s Theory of Self Care holds that individuals have the ability to perform self-care and that people are continuously engaged in self-care activities in the process of daily living to meet their requisite needs. Also according to Orem the goal of self care is self monitoring and promotion of health and well-being. The results of research question one would then indicate that elders with type 2 diabetes are capable of diabetes self care as evidenced by the mean HbA1c level of 8.13%. Orem also believed age related deficits impact self care abilities. According to this data while decreasing visual acuity does impact diabetes self care values, it is the ability to cognitively reason that holds greater significance to self care.

**Research Question Two.**

What is the impact of basic conditioning factors on health literacy among elders with type 2 diabetes?

Question two focuses on elder’s basic conditioning factors that may impact health literacy either positively or negatively depending on the variable explored. The literature suggested increased age had a negative impact on health literacy. Being of female gender was expected to positively impact health literacy as was being married. Membership within minority ethnic groups was theorized to increase the number of cases of diabetes. More years of formal education undertaken by individuals was expected to positively impact health literacy levels. Familiarity with English and greater years of residency in the United States were expected to positively impact health literacy scores. Most of the variables had no influence on participants’ health literacy levels. There was an unpredicted association between ethnicity and health literacy evidenced by those who self
identified as being non-white having higher health literacy scores. There was a positive association between years of U.S. residency and years of formal educational when compared against health literacy levels for the participants. When tested statistically the variable for years of U.S. residency was not significant; however, a moderately strong positive association between health literacy and years of education was seen. Then within this study the variable for years of formal education was the best predictor of health literacy.

There is little research literature examining any of the basic conditioning factors impact on diabetes self care. Recently some diabetes researchers have begun to explore the impact of culture on diabetes complications rates. Brown, Garcia, Kouzakanis and Hannis in 2000 published work that displayed the positive impact of culturally competent diabetes education on glycemic control among Mexican–Americans with type 2 diabetes. In 2000 a study by Tucker, Bermudez and Casteneda found a potential link between cultural and glycemic control in Caribbean elders with type 2 diabetes. The influence of culture on diabetes self care activities appears to be contradicted in the work of Keyserling and colleagues in 2002 among African-American women who did not demonstrate any significant changes in self care behaviors after a culturally derived educational intervention. In the current study there was an unpredicted association between membership in an ethnic minority and higher scores on the STOFHLA.

Within the literature there are no evident studies that relate gender to health literacy. Studies within diabetes research related to health literacy are few and none
isolate gender as a potential variable impacting health literacy. In this study there was a slight association between female gender and higher health literacy scores.

The issue of marital status and its impact on health literacy is not well documented in the literature. In this study marital status was not a statistically significant factor related to health literacy.

Orem’s Theory of Self Care contends that basic conditioning factors impact self care abilities in individuals. Evidence from this study indicated that from among the basic conditioning factors only years of formal education had a statistically significant impact on health literacy. The association found in the study data between ethnicity and health literacy was not in the direction predicted by the theorized model. Therefore, diabetes health education programs need not be so tailored to each ethnic group that the generalizability of the information is diluted.

Research Question Three.

What is the impact of exposure to structured diabetes education on health literacy among elders with type 2 diabetes?

Health literacy in elders is positively impacted by prior exposure to formal diabetes educational programs. It was reasoned that attendance in a formal diabetes education class should raise health literacy as attendance in any formal education class impacts overall literacy. However, if the content of these diabetes educational sessions is not congruent to increasing self care, then health literacy rates would also be lower. When the data was fitted to a regression model there was no support for the assumption
that prior exposure to diabetes classes favorably shaped participants health literacy scores.

Most of the research studies on diabetes interventions in the literature reference some type of diabetes education. While there is some evidence that diabetes education can impact diabetes knowledge and even glycemic control in the short term, to date there is little evidence for the effectiveness of diabetes educational interventions in the long term. Missing from the diabetes literature are research studies that explore the impact of how diabetes knowledge influences health literacy, how the aging process impacts learning about diabetes self cares, as well as what the affect of overall literacy is on the learning and retention of diabetes related information.

The use of formal informational systems utilized in a social setting supplements experimental knowledge in determining how requisites should be meet and who according to Orem’s Theory of Self Care. Also according to Orem’s theory individuals acquire the abilities to perform self care through the social process of observation. In this study the level of health literacy was shown to be most impacted by the variable of years of formal education. Attendance in a diabetes educational class did have an association with increased health literacy.

**Research Question Four.**

What is the impact of exposure to structured diabetes education on disease specific knowledge among elders with type 2 diabetes?

Literature suggests prior exposure to formal diabetes educational programs positively impacts on the diabetes specific knowledge of by elders. There was some
evidence that those study participants who had previously attended diabetes educational classes did possess additional disease specific knowledge ($\beta = -0.270$) when compared to those study participates who had not attend formal diabetes educational classes. Again within the literature are research studies related to diabetes educational interventions impact diabetes knowledge as an intermediary for diabetes self care or glycemic control, but no intervention has yet to evidence long term positive results.

According to Orem learning self care happens in social situations through modeling. Study evidence did show that those who had attended a diabetes education class did slightly better on the test of diabetes specific knowledge. This indicates several possibilities that are congruent with Orem and self care. First, that elders with diabetes are learning about their condition both in formal diabetes educational classes and possibly elsewhere. Second, if that the content or method of delivery of diabetes specific information within diabetes educational classes for some elders is marginally effective in present formats.

**Research Question Five.**

What is the impact of health literacy on diabetes self-care among elders with type 2 diabetes?

Literature suggests that diabetes self-care is negatively impacted by low levels of health literacy. The study data demonstrated that there was a significant, moderately strong theorized negative correlation between HBA1c levels and health literacy scores for the study participants ($\beta = -0.526$).
Much of the research work in the literature on health literacy explores the impact of health literacy on increased risk of hospitalizations across many chronic conditions. Schillinger, et al (2002) published a work related to the positive correlation between decreased health literacy and poor glycemic control among persons with type 2 diabetes. In 1999, Journal of the American Medical Association Council on Scientific Affairs issued a statement from their study that indicated those with decreased health literacy had increased chances of communication difficulties with health care providers that could result in an adverse impact on complex medical conditions. This study also demonstrated that the health literacy levels of the participants strongly affected their HbA1c scores as was expected.

Orem’s Theory of Self Care holds that learning is impacted by the developmental stages of each person. It had been assumed that decreasing vision, slower manual dexterity and alteration in cognition would adversely impact HbA1c levels through the mediator variable of health literacy. The study data demonstrated that age related deficits did not adversely impact elder’s self care levels.

**Research Question Six.**

What is the impact of health literacy on disease/diabetes specific knowledge among elders with type 2 diabetes?

Literature suggests that low levels of health literacy negatively impact elders’ diabetes disease specific knowledge. Disease specific knowledge and health literacy did show a statistically significant, positive theorized correlation between them ($\beta = .425$).

Much of the research done on health literacy to date has been with those who have one or
more chronic health conditions and of these only a few studies have examined the
interrelationship of diabetes and health literacy. There are no studies evident that have
explored health literacy and diabetes specific knowledge as separate variables.

The literature has spoken to other chronic conditions where lower levels of health
literacy were linked to decreased knowledge of the conditions explored. Private practice
as a diabetes educator demonstrated many cases where individuals with low levels of
health literacy also possessed limited understanding of what diabetes is. Current diabetes
educational programs do not routinely screen clients for health literacy. The simple
addition of utilization of one of the screening tools for health literacy prior to diabetes
educational content instrumentation may allow diabetes educators to tailor program
content to the appropriate level of client understanding. Orem’s Theory of Self Care
states that self care actions are preformed to meet known self care requisites. Higher
levels competency in health literacy impacted elders’ abilities to learn about diabetes as a
condition.

Research Question Seven

What is the impact of diabetes specific knowledge on diabetes self care among elders
with type 2 diabetes?

A fair amount of literature suggests that low levels of diabetes specific knowledge
influences worse diabetes self care. While there was a statistically significant, moderate
relationship between diabetes disease knowledge and HbA1c with \( b = -0.302 \), the explained
variance was only \( r^2 = 0.091 \). With only 9% of the variance in diabetes self care attributed
to knowledge of diabetes as a disease, it would appear that much of the informational
content of current diabetes educational programs needs to be rethought. If diabetes specific knowledge has so small an influence on diabetes self care then a reduction in the amount of information delivered on this subject within diabetes educational programs may be needed. Or perhaps the issue is that elders with diabetes are capable of self care management without learning materials dictated in current diabetes educational programs, or that what health care professionals think elders with diabetes need to learn about their condition is only a very small part of self care.

Orem describes different systems of professional nursing practice related to self care. In the partially compensatory systems the nurse and the client share responsibility for care. Diabetes education has the goal of informing people with diabetes about how to care for their condition. Knowledge of a concept must precede ability to care. In this study elders’ knowledge of diabetes as a condition appeared to have little impact on diabetes self care; however, no data was gathered to explore the exact curricula content or information delivery styles of the diabetes educational programs attended.

Model Hypotheses One.
Age related deficits, health literacy, and diabetes specific knowledge impact diabetes self-care.

Only two of the stage one age related deficits had significantly impact on diabetes self care in the theorized directions: visual acuity ($\beta = .360$) and cognitive reasoning ($\beta = -.526$). Health literacy also had a statistically significant impact in the theorized direction ($\beta = -.217$). The explained variance of these two variables on diabetes self care was $r^2 =$
.595 or almost 60% of the total variance in HbA1c levels, while diabetes specific knowledge did not have a significant effect.

Cognition as a component of prior diabetes research has generally been examined from the standpoint of memorization of diabetes health care information. This study demonstrated that for these participants the variable of memory did not significantly impact diabetes self care, but the variable for cognitive reasoning ability was significant. This information holds importance for diabetes educators on how ineffective current diabetes educational programs that are strongly structured to a memorization may be for elderly clients.

If the elder is truly performing self care then there are basic levels of physical and mental factors that need to be met. Good visual acuity for persons with diabetes aides in checking feet for unfelt punctures or infections as well as medication administration or reading nutritional labels for dietary information. While it was expected that a certain degree of manual dexterity is necessary for persons with diabetes to manipulate the items to manage the condition (blood lancing, daily self glucose monitoring, opening medication bottles, drawing up and injecting insulin); study results did not support this expectation. The cognitive reasoning factor is necessary to order multiple sources of diabetes information to manage this complex condition effectively.

Within Orem’s Theory, self care is a continuous process with competency levels impacted by development. Health care needs within this theoretical framework are those alterations in health that result from illness, injury, or disease process. The age related
developmental deficits of cognitive reasoning and visual acuity along with health literacy were shown to influence diabetes self care. The literature strongly supports the effect of health literacy on diabetes self care. For example since there is little published research related to visual acuity and diabetes self-care, this study provided new important information for these variables.

Model Hypotheses Two.

Basic conditioning factors and attendance at diabetes educational classes impact health literacy.

Attendance at a diabetes educational class was not a statistically significant predictor of health literacy. Among the basic conditions factors only years of formal education ($\beta = .548$) impacted on health literacy levels.

Review of the literature indicated that the predicted positive association between years of education and increased health literacy should be and was demonstrated by the study data. Those diabetes educators who only rely on a client’s reported years of education without verification of health literacy may not be serving the client fully. While it appears intrinsic that increased years of education should allow for increased knowledge, this increased information may not be in the formal of health care knowledge for all persons.

The basic conditioning factors within Orem’s Theory of Self Care include those areas gathered as demographic data in this study. An unexpected result was that those who reported themselves a non-white had higher levels of health literacy. Historically those from ethnic minority backgrounds have been considered to be at a disadvantage in
obtaining health care information. While increased health literacy does positively affect diabetes specific knowledge, this model demonstrated that this relationship does not exist in the reverse (diabetes specific knowledge positively impacting health literacy). For those involved in diabetes education the increased health literacy evidenced by ethnic minority participants may indicate that the conceptual model of diabetes education is effective as it stands.

Model Hypotheses Three.

Attendance at a diabetes educational class impacts diabetes disease specific knowledge.

The study data indicated that there exists a negative, unexpected association between attending a diabetes educational class and an individual’s increased knowledge of diabetes as a disease state ($\beta = -.270$). Diabetes research studies on the impact of an educational interaction related to knowledge of diabetes have only been effective in the short term for eliciting alterations in glycemic control. The data collected for this study indicated that those who reported attending a diabetes educational class did have a greater knowledge of diabetes than those individuals who did not attend a diabetes educational class.

Self care according to Orem’s theory is composed of actions that are directed by the individual related to healthy functioning. These actions are dependent on the person’s abilities. Education is presumed to precede an increase in knowledge. The fact that attending a diabetes educational session did not increase to engage in self-care might be attributed to what the content is within diabetes educational programs. Since the study
data indicated that memory is not a predictor of self care, perhaps a diabetes program information content directed to problems solving exercises on diabetes as a condition might be more beneficial for elders.

Summary of All Models

The study data indicated that cognitive memory is not a predictor of diabetes self care, yet much of diabetes educational material is based on memorization of facts. The strongest predictor of diabetes self care was cognitive reasoning abilities ($\beta = -.526$). This has implications for the adjustment of diabetes educational program content into areas that stress problem solving over memorization. Vision with a beta of .360 was the next strongest predictor of diabetes self care. While some diabetes educational information has been developed for the visually impaired person, the majority of diabetes educational materials remain in print form. The visual findings from the study reinforced the need to retain print materials for educational content. Health literacy as a predictor of diabetes self care ($\beta = -.217$) in this study is congruent with the literature reviewed. Diabetes education may be more effective if clients are first screened for health literacy prior to diabetes education.

Study Limitations

All research studies possess limitations. Limitations for this study included problems with the instruments selected, study procedural issues, subject restrictions, and environmental factors.
The number of study instruments themselves utilized was a limitation. There were five separate questionnaires employed to gather information. Each instrument possessed many of individual questions items. Each study participant had to answer a total of 125 questions to complete the survey instruments for this study. Subject fatigue related to the length of time to complete the set of questionnaires caused some subjects (N = 8) to withdraw prior to completion of the entire series.

Another study limitation was the researcher’s decision not to perform psychometric retesting to verify reliability on each of the study instruments. Each of the selected instruments has been utilized by other researchers, but no other study has sought to use these instruments as a collective entity or with elders with diabetes as subjects. The objective here was to demonstrate that the instruments as they now exist were portable and time effective enough to be utilized in a multiple battery in a community setting. The entry of questionnaires data as total testing scores rather than as discrete items also was a study limitation. This inability to be certain that the instruments are truly measuring the concepts that they were designed for in this population and settings is a limitation.

The time allotted by the researcher for the participant to complete the study questions (one hour) was a major study limitation. Prior to the start of this study a series of pilot testing among elders in community was undertaken. In the pilot test the one hour time frame was sufficient for completion of all study instruments. However, when the actual study data was being gathered in many cases this time frame was insufficient for the participant to feel completely at ease in the study process. These feeling of unease
may have caused some study participants to select answers on the questionnaires that did not reflect true levels of knowledge about the subject.

Only the study author was involved in data collection, this limited how many elders could be recruited at each study site. The study protocols and instructions were given by the researcher from a printed script, however, since each subject was individually instructed there are issues with intra-rater reliability in regard to subject instruction.

Lastly, the financial cost of the HbA1c meters was a major limitation. Limited financial resources placed an upper limit on the number of potential study participants at the lower statistically significant number of 75. The ability to increase the number of study participants could have provided additional evidence of the relationships.

Study participant limitations had to do with subject fatigue during data collection. Many of the study participants required frequent rest breaks in the data collection time related to fatigue. Since the researcher opted to collect data at various community sites, there were differences in environment conditions that possibly impacted the quality of data collected. Environmental factors such as temperature variations, lighting conditions, noise levels, and space to set up study were not controlled for in this project. Limiting the number of confounding variables from the environment would lead to increased ability to judge the strength of the relationships between the study variables.
Implications for Nursing Practice

There are several findings from this study that are significant for nursing practice. Nurses like most health care professionals tend to see elders as less than skillful in handling their own self care. The overall study average HbA1c level of 8.13% for this group of elders spotlights a positive note. This average HbA1c appears to indicate that as a collective, many elderly persons with diabetes living in community are managing their type 2 diabetes self cares adequately.

The presence of significant correlations between years of education and ethnicity (r = .49) and between ethnicity and health literacy (r=.42) may indicate that there is more uniformity among the population related to health care knowledge. This uniform trend in health literacy across populations could indicate that there is less need to formulate health care programs for each type of cultural background.

The information gathered on elder’s cognitive processes that indicated that reasoning ability, rather than memory, was the more important variable in diabetes self care. Nurses serving as diabetes educators, then, may wish to reexamine the content of diabetes educational programs for those programs over loaded with memorization pieces about diabetes while not stressing problems solving abilities. The physical alternations in an elder’s manual dexterity had no profound impact on their self care levels, but changes in visual acuity influenced diabetes self care scores. Nurse diabetes educators then should ensure that all printed material has larger and most distinct font styles.
This study provides new information about two basic assumptions in diabetes education and diabetes self care practices. One of the mainstays of diabetes self care is the daily monitoring of blood sugar levels; yet in this study the data demonstrated that those who independently performed the finger stick technique (a precursor to self monitoring of daily blood sugars) had higher HbA1c levels or worse diabetes self care. However, if should be noted that even when people with diabetes correctly perform recommended self care that there is no guarantee that HbA1c levels will be lowered. The statistically significant link between diabetes specific knowledge and diabetes self care has implications for curricula content alteration in diabetes educational programs. The explained variance of 9% between diabetes specific knowledge and self care ($\beta = -302$) was low. This does not indicate that diabetes education is not important to diabetes self-care, but rather implies that there might be other factors besides diabetes education to consider when assessing self care. The lower scores on the test of diabetes specific knowledge from those elders who reported attending diabetes educational classes is also a point that potentially impacts nursing practice.

Future areas of research might include refinement of this study by repeating it in additional populations of elders with diabetes. Increasing the number of study subjects to gain statistical power is yet another avenue for future study refinement. Several small studies that explore methods to shorten all study instruments and yet retain the validity and reliability of each instrument should be undertaken. Additional studies in which there is control of environmental factors (light, temperature, noise levels) needs to be undertaken to see how each of these might have impacted the current study.
Studies that could also potentially grow out of the current research explore how instruments utilized in this study related to other already proven instruments. A study that seeks to compare the length of time for finger stick technique to manual dexterity may yield additional information related to self care in persons with diabetes. Exploration of the accuracy of the home testing meters used in this study against laboratory values for HbA1c is yet another potential study that might develop from this project. Examination of individuals’ levels of cognition through reasoning abilities and manual dexterity could provide information on how these variables interact related to self care. Access to one of the newly developed home-based computerized apartments could be utilized to gather objective data on nutritional and exercise patterns among person with diabetes following diabetes educational sessions. Such information would provide evidence of educational program effectiveness or point out deficiencies between diabetes informational theory and actual practice by clients.

Future Recommendations

The number and degree of study limitations evidence a need for further refinement of this project. Initial recommendations would center on reproduction of this study to the control of as many of the environmental features as possible. A centralized location with researcher control of environment factors may directly influence the quality of the data gathered. Also increasing the number of data collectors related to the time intensive study protocol might aid in subject retention levels.

Secondly the recommendation to perform psychometric analysis of the instruments employed in this study to discover if a shorter version of each might prove
beneficial prior to re-testing this model. If such revision of the instruments is not possible, then under environmentally controlled conditions, a greater time period for each participant to complete the series of instruments is recommend.

A third study recommendation would be to have the study procedures and instruction videotaped. This would decrease the chance that unintended alterations might occur in instruction of subjects and increase the intra-rater reliability.

After these revisions to the study have been accomplished, then a testing of this study’s revised model of factors that influence diabetes self-care in elders would be warranted to see if holds up to scrutiny. Testing of the theoretical and/or revised model in other disease entities or other age groups would also be recommended to gauge the model generalizability. Also the development of an additional study to see if an elder’s ability to reasoning can be improved on by altering the diabetes educational curriculum to one steeped in reasoning and problem solving to gauge effectiveness of self care for those study participants.

Once the model has been sufficiently validated it is recommended that interventional studies of diabetes self-care be centered on factors of reasoning and health literacy. These projected studies will need to account for variations in reasoning abilities, critical thinking skills, formal and informal education about the condition

Summary

This study was designed to test a theoretical model of factors that impact diabetes self-care among elders with type 2 diabetes. Based on research it was hypothesized that
age-related physical deficits would have a large impact on the elder’s ability to perform self-care. Analysis of the data demonstrated that the cognitive ability to reason, visual acuity and health literacy had statistically significant impact on the participant’s ability to perform diabetes self-care. The ability to keep HbA1c levels lower was also demonstrated by the person’s increased health literacy scores.

The results of this study contained information that is new to diabetes self care. First, there is no documented research that examines the impact of the study variables on self care (i.e. how age related deficits impact diabetes self care). Rather the diabetes research within the literature focuses on how diabetes impacts variables like cognition or vision. Second, the mean average of HbA1c levels for study participants being only slightly above the American Diabetes recommend level indicated that elders with diabetes living in community are managing their diabetes better than anticipated. Third, cognitive memory has was not a predictor of diabetes self care, while the largest predictor of self care was ability to reason.
Appendix A
Permission to Use MDRTC

If yes, how are you going to use these materials?

☐ Research Project
☐ Clinical Outcome Evaluation
☐ Education Program Evaluation
☐ Master or doctoral project/honor

Please read the following before submitting this form. By submitting this form, you are agreeing to abide by the statement.

You have our permission to reproduce and use these instruments and materials as long as the Michigan Diabetes Research and Training Center is acknowledged in any instrument, report or publication resulting from their use.

The information in the Survey Instruments is not a tool for self-diagnosis or a substitute for professional care.

[Buttons: Agree & Submit, Reject]
Permission to Use ERB & ERC

http://email.nursing.arizona.edu - Fed: Fw: request to use everyday cognition battery - Microsoft Internet Explorer

From:        James Allaire [jallaire@nursing.arizona.edu]
To:          jallaire@nursing.arizona.edu
Cc:          [Redacted]
Subject:     Fw: Fw: request to use everyday cognition battery
Attachments: [Attached files]

Dear Mr. Allaire,

Your study sounds like an interesting one and I would be happy to allow you to use the ECB. The only thing you have to decide now is which of the five tests you are going to use.

I would suggest eliminating the ECB Working Memory test (E) as it really isn't that good. The three remaining tests (Knowledge, Memory, and Reasoning) are all very good but they do get at different things. If you wanted a measure that assessed knowledge, for example, then I would choose the knowledge test since everyone gathers knowledge memory. If you want some sort of a straightforward everyday problem solving test then the reasoning measures is your best bet. The knowledge test is just good to have to see how much people know.

Anyway, take a look at them and let me know if you have any questions etc.

Best,

Jason

>attached are all the files you need to use the ECB. Below is a
>description of each:
>
>ECBROBS = answer key
>ECBKNOW = ECB Knowledge test
>ECBREAS = ECB Inductive Reasoning test
>ECBREC = ECB Declarative Memory test
>ECBRWRT = The script for the ECP Working Memory Test
>ECBTEST = ECB Working Memory Test

Done.
Appendix B
Informed Consent:

Comparison of Health Literacy Among Elders with Type 2 Diabetes

I am being invited to participate voluntarily in the above-titled research project. The purpose of this project is to find out elders with type 2 diabetes have different

SELECTION CRITERIA
I am being invited to participate because I am 62 years of age or older and have been diagnosed with diabetes type 2. A total of 75 subjects overall will be recruited for this study. Approximately 33 subjects will be enrolled in this study from this site.

PROCEDURE(S)
If I agree to participate, I will be asked to consent to the following: one-hour session to complete the study questionnaire forms, study tests, and to monitor my blood for my current 3-month sugar level (glycated hemoglobin). I understand that this is the only time requirement needed for my participation in this study.

RISKS
A drop of my blood will be needed to test my glycated hemoglobin level. A finger stick blood draw may cause discomfort from the insertion of the needle, bruising at the insertion site, fainting (infrequent), and infection at the needle stick site.
BENEFITS
I may directly benefit from participation in this study because I will be given the results of my glycated hemoglobin levels to judge my diabetes control over the past three months.

CONFIDENTIALITY
I have a right to privacy. All information obtained in this study that can be identified with my name will remain confidential as far as possible. My name will not be revealed in any reports or publications from this study without my expressed consent. Individuals involved in this study, qualified monitors and auditors from the Health Authorities, such as the Food and Drug Administration, National Institute of Health, members of the Primary Investigator’s Dissertation Committee, may inspect and copy my medical records, where appropriate and necessary.

PARTICIPATION COSTS AND SUBJECT COMPENSATION
I will not be incurring any expense to participate in this study. The time required to complete the study questions should be approximately 1-hour. I will receive no financial compensated for my participation, but I will be given the test results of my glycated hemoglobin level to share with my primary care provider.

LIABILITY
Side effects or harm are possible in any research program despite the use of high standards of care and could occur through no fault of mine or the investigator involved. Known side effects have been described in this consent form. However, unforeseeable harm also may occur and require care. I do not give up any of my legal rights by signing this form. In the event that I require or am billed for medical care that I feel has been caused by the research, I should contact the principal investigator, Jean Benzel-Lindley, PhD (c ), RN, (702)565-7713. If I have questions concerning my rights as a research subject, I may call the Human Subjects Committee office at (520) 626-6721.

AUTHORIZATION
BEFORE GIVING MY CONSENT BY SIGNING THIS FORM, THE METHODS, INCONVENIENCES, RISKS, AND BENEFITS HAVE BEEN EXPLAINED TO ME AND MY QUESTIONS HAVE BEEN ANSWERED. I MAY ASK QUESTIONS AT ANY TIME AND I AM FREE TO WITHDRAW FROM THE PROJECT AT ANY TIME WITHOUT CAUSING BAD FEELINGS OR AFFECTING MY MEDICAL CARE. MY PARTICIPATION IN THIS PROJECT MAY BE ENDED BY THE INVESTIGATOR OR BY THE SPONSOR FOR REASONS THAT WOULD BE EXPLAINED. NEW INFORMATION DEVELOPED DURING THE COURSE OF THIS STUDY WHICH MAY AFFECT MY WILLINGNESS TO CONTINUE IN THIS RESEARCH PROJECT WILL BE GIVEN TO ME AS IT BECOMES AVAILABLE. THIS CONSENT FORM WILL BE FILED IN AN AREA DESIGNATED BY THE HUMAN SUBJECTS COMMITTEE WITH ACCESS RESTRICTED TO THE PRINCIPAL INVESTIGATOR, JEAN BENZEL-LINDLEY, PHD (C), RN, OR TO
MEMBERS OF THE PRINCIPLE INVESTIGATOR’S DISCERNATION COMMITTEE WITHIN THE COLLEGE OF NURSING. I DO NOT GIVE UP ANY OF MY LEGAL RIGHTS BY SIGNING THIS FORM. A COPY OF THIS SIGNED CONSENT FORM WILL BE GIVEN TO ME.

_____________________________ _______________________
Subject's Signature        Date

_____________________________ _______________________
Parent/Legal Guardian (if necessary) Date

_____________________________ _______________________
Witness (if necessary)         Date

INVESTIGATOR'S AFFIDAVIT
I have carefully explained to the subject the nature of the above project. I hereby certify that to the best of my knowledge the person who is signing this consent form understands clearly the nature, demands, benefits, and risks involved in his/her participation and his/her signature is legally valid. A medical problem or language or educational barrier has not precluded this understanding.

_____________________________ Date
Signature of Investigator

6/2003
<table>
<thead>
<tr>
<th>Screening Criteria</th>
<th>Yes: continue screening</th>
<th>No: not eligible for study</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Reports as person with type 2 diabetes?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2) Reports as being age 62 or greater?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3) Reports as performing diabetes self-care?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4) Is able to correctly read aloud a randomly selected paragraph on informed consent form?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5) Is able to manipulate papers and to sign informed consent?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6) Is able to obtain a score of 17 or greater on MMSE?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Mini Mental State Examination

<table>
<thead>
<tr>
<th>Question /Action</th>
<th>Administration Instruction</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Orientation</strong></td>
<td>♦ Ask for the date. Then ask especially for parts omitted, e.g. “Can you tell me what season it is?” 1 point for each correct answer. ♦ Ask in turn “Can you tell me the name of this place?” (town, country, etc.) 1 point for each</td>
<td></td>
</tr>
<tr>
<td>♦ What is the (year) (season)(date) (day)(month)?—5 points</td>
<td></td>
<td></td>
</tr>
<tr>
<td>♦ Where are we: (state) (country)(town)—5 points</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Registration</strong></td>
<td>♦ Ask the patient if you may test this or her memory. Then say the name of three unrelated objects, clearly and slowly, about 1 second for each. After you have said all three, ask him or her to repeat them. This first repetition determines his or her score (0-3), but keep saying them until he or she can repeat all three, up to six trials. If he or she does not eventually learn all three, recall cannot be meaningfully tested.</td>
<td></td>
</tr>
<tr>
<td>♦ Name three objects (apple, penny, table) 1 second to say each. Then ask the patient all three after you have said them. Give one point for each correct answer. Then repeat them until he or she learns all three. Count trials and record.---3 points</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Attention &amp; Calculation</strong></td>
<td>♦ Ask the patient to begin with 100 and count backwards by 7. Stop after five subtractions (93, 86, 79, 65). Score the total number of correct answers. ♦ If the patients cannot or will not perform this task, ask him or her to spell the word “world” backward. The score is the number of letters in correct order, e.g. dlrow =5, dlorw =3</td>
<td></td>
</tr>
<tr>
<td>♦ Serial 7’s. 1 point for each correct. Stop after five answers. Alternatively spell “world” backwards.---5 points</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Recall</strong></td>
<td>♦ Ask the patient if he or she can recall the three words you previously asked him or her to remember. Score 0-3.</td>
<td></td>
</tr>
<tr>
<td>♦ Ask for three objects repeated above. Give 1 point for each correct answer.— 3 points</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Language</strong></td>
<td>♦ Naming: Show the patient a wristwatch and ask him or her what it is. Repeat for pencil. Score 0-2. ♦ Repetition: Ask the patient to repeat the sentence after you. Allow only one trail. Score 0-1. ♦ Reading: On a blank piece of paper print the sentence “Close your eyes”, in letters large enough for the patient to see clearly. As him or her to read it and do what it says. Score 1 point only if he or she actually closes his or her eyes. ♦ Writing: Give the patient a blank piece of paper and ask him or her to write a sentence for you. Do not dictate a sentence, it is to be written spontaneously. It must contain a subject and verb and be sensible. Correct grammar and punctuation are not necessary. ♦ Copying: On a clean piece of paper, draw intersecting pentagons, each about 1 inch,</td>
<td></td>
</tr>
<tr>
<td>♦ Name a pencil, and watch.—2 points</td>
<td></td>
<td></td>
</tr>
<tr>
<td>♦ Repeat the following “No ifs, ands, or buts”—1 point</td>
<td></td>
<td></td>
</tr>
<tr>
<td>♦ Follow a three-stage command: “Take a paper in your right hand, fold it in half, and put it on the floor.”---3 points</td>
<td></td>
<td></td>
</tr>
<tr>
<td>♦ Read and obey the following: CLOSE YOUR EYES.—1 point</td>
<td></td>
<td></td>
</tr>
<tr>
<td>♦ Write a sentence.—1 point</td>
<td></td>
<td></td>
</tr>
<tr>
<td>♦ Copy design (overlapping pentagons)—1 point</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
and ask him or her to copy it exactly as it is. All 10 angles must be present, and 2 must intersect to score 1 point. Tremor and rotation are ignored.

| Possible Total Score: 30 | Subject’s Total Score: ____________ |
SNELLEN TEST OF NEAR VISUAL ACUITY

HOLD THIS SHEET ABOUT 14 INCHES FROM YOUR FACE. PLEASE READ OUT LOUD THE SMALLEST LINE YOU CAN CLEARLY SEE. YOU MAY USE YOUR GLASSES IF YOUR CHOOSE TO.

SNELLEN VISUAL ACUITY SCORE: _________________
DEMOGRAPHICS

1) Gender:  Male__________  Female ________________

2) Date of Birth (month/day/year): ________________________

3) Martial Status:  Single ________ Married ________

        Divorced/Separated _______ Widowed ______

4) Ethnic Identification: Hispanic _____ Asian_____ Black______

        Native American ___ White_____ Other: _______

5) Years of residence in US: ____________________________

6) Country of birth: __________________________________

7) What language did you first learn as a child? _____________

8) Years of formal education:

     8 years or less _________ 9-12 years ______________

     13-15 years _____________ 16 years or more __________

9) Year you were diagnosed with diabetes: ________________

10) Have you ever attended a formal diabetes education class? YES ___ NO ___
11) If you answered yes to the question above, what level of Health professional taught the class as the primary instructor?

   MD/DO ________  RN ___________

   LPN _______  Dietitian _______

   Don’t know _______
## Test of Manual Dexterity & HbA1c Level

<table>
<thead>
<tr>
<th>Category</th>
<th>Performs Independently = 3</th>
<th>Requires Assistance: Verbal or Manual = 2</th>
<th>Requires Total Assistance = 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subject able to assemble all necessary items (lancing devise, lancet, meter strip, and HbA1c meter) to perform finger stick technique.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subject is able to uncap lancing device?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subject able to load &amp; unsheathe lancet within lancing device?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subject able to set trigger mechanism on lancing device?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subject able to recap lancing device?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subject able to cleanse skin at test site?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subject able to obtain sufficient blood sample for HbA1c using loaded lancing device?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subject able to transfer blood sample to HbA1c meter strip of testing?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subject able to insert HbA1c meter strip with blood sample into HbA1c meter?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subject able to obtain HbA1c meter reading of sample?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subject able to verbalize if HbA1c meter sample result is within current American Diabetes Association standards for HbA1c levels.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

HbA1c reading: _____________________
Jebsen-Taylor Hand Function Test

You will be repeating the skills (stacking checkers, moving cans, sorting cards, etc) demonstrated to you. After the researcher shows you a task you are to complete that task with your right hand first and then your left hand. There are seven separate tasks in all.

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Time To Complete Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Right</td>
</tr>
<tr>
<td>1. Writing (Able to copy pentagram diagram and written sentences)</td>
<td></td>
</tr>
<tr>
<td>2. Card Sorting (Able to sort standard deck of cards into suites)</td>
<td></td>
</tr>
<tr>
<td>3. Picking up small items (paper clips, pennies, disks, etc)</td>
<td></td>
</tr>
<tr>
<td>4. Stacking checkers (Able to stack standard number of checker set into 3 columns)</td>
<td></td>
</tr>
<tr>
<td>5. Simulated feeding (Able to pick up spoon, soup-cup, and pantomime eating soup)</td>
<td></td>
</tr>
<tr>
<td>6. Picking up light weigh items (Able to pick up and move empty soda cans across table and back)</td>
<td></td>
</tr>
<tr>
<td>7. Picking up heavier weighted items (Able to pick up filled soda cans and move them across table and back)</td>
<td></td>
</tr>
</tbody>
</table>

Total time to complete all tasks

Dominate hand reported as:
Everyday Cognition Battery

ECB Recognition Questionnaire

In the following questionnaire you will be asked to study different everyday printed material such as medicine labels and nutrition label for 1 minute. You will then be asked memory questions. You will be asked to turn the page and circle the correct answers to each memory question. Because this is a memory test, you cannot turn back to look at the printed material after you have studied it. Please try to answer all the questions as well as you can, and do not worry if the problems seem difficult. Just do your best. Any questions?

You will have 1 minute to study each printed text. Please study very carefully. You will then have 1 minute to turn the page and circle your answers. If you are ready, turn the page and study the three labels now.

---

Copyright 1997 Jason Allaire and Michel Marsiske, Institute of Gerontology and Department of Psychology, Wayne State University.
You will have 1 minute to study the medication labels below. Please study them very carefully. Do not turn the page until you are told.

BEGIN STUDYING NOW.

<table>
<thead>
<tr>
<th>DATE OF PRESCRIPTION:</th>
<th>07-31-97</th>
<th>RX: 081221</th>
</tr>
</thead>
<tbody>
<tr>
<td>DR: Deems, J.M.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Melissa Hardin</td>
<td>REFILLS: 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EXPIRES: 09-23-97</td>
<td></td>
</tr>
<tr>
<td>TAKE 1 CAPSULE ON TUESDAY AND THURSDAY, AT BREAKFAST</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LANOXIN – 0.125 mg</td>
<td>60 CAPSULES</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DATE OF PRESCRIPTION:</th>
<th>07-31-97</th>
<th>RX: 081222</th>
</tr>
</thead>
<tbody>
<tr>
<td>DR.: Cooper, M.W.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Melissa Hardin</td>
<td>REFILLS: 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EXPIRES: 09-30-97</td>
<td></td>
</tr>
<tr>
<td>TAKE DAILY WITH MEALS AND AT DINNER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VASOTC – 10 mg</td>
<td>60 CAPSULES</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DATE OF PRESCRIPTION:</th>
<th>07-31-97</th>
<th>RX: 081223</th>
</tr>
</thead>
<tbody>
<tr>
<td>DR.: Deems, J.M.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Melissa Hardin</td>
<td>REFILLS: 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EXPIRES: 09-17-97</td>
<td></td>
</tr>
<tr>
<td>TAKE DAILY, EVERY MORNING AND BEFORE BED</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRINIVIL – 5 mg</td>
<td>60 CAPSULES</td>
<td></td>
</tr>
</tbody>
</table>

PLEASE DO NOT TURN THE PAGE UNTIL YOU ARE TOLD.
Answer the following questions without looking back on the previous page. Do not look back on the previous page. (* = correct answer)

1) On which days is Mrs., Hardin supposed to take her Lanoxin?
   A. Tuesday and Thursday*
   B. Monday and Sunday
   C. Tuesday and Wednesday
   D. Whenever she want to

2) In which month do all three of her medications expire?
   A. January
   B. September*
   C. May
   D. August

3) Which one of these medications was Mrs. Hardin not prescribed?
   A. Lanoxin
   B. Vasotc
   C. Prinivil
   D. Furosemide*

4) Who are the two doctors that prescribed these drug medications for Mrs. Hardin?
   A. Dr. Deems and Dr. Hong
   B. Dr. Cooper and Dr. Deems*
   C. Dr. Cooper and Dr. Stevens
   D. Dr. Hill and Dr. Buck

5) How many capsules was Mrs. Hardin given in each prescription?
   A. 60 capsules*
   B. 50 capsules
   C. 100 capsules
   D. She was given a different amount for each prescription.

PLEASE DO NOT TURN THE PAGE UNTIL YOU ARE TOLD.
You will have 1 minute to study the nutrition label below. Please study it very carefully. Do not turn the page you are told. BEGIN STUDYING NOW.

<table>
<thead>
<tr>
<th>Nutrition Facts</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Serving Size</td>
<td>1 tbsp (14 g)</td>
</tr>
<tr>
<td>Servings Per Container</td>
<td>about 32</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Amount Per Serving</th>
<th>Calories</th>
<th>Calories for Fat</th>
<th>% of Daily Values*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Total Fat</td>
<td>11 g</td>
<td></td>
<td>17%</td>
</tr>
<tr>
<td>Saturated Fat</td>
<td>7 g</td>
<td></td>
<td>36%</td>
</tr>
<tr>
<td>Cholesterol</td>
<td>30 mg</td>
<td></td>
<td>10%</td>
</tr>
<tr>
<td>Sodium</td>
<td>90 mg</td>
<td></td>
<td>4%</td>
</tr>
<tr>
<td>Total Carbohydrate</td>
<td>0 g</td>
<td></td>
<td>0%</td>
</tr>
<tr>
<td>Protein</td>
<td>0 g</td>
<td></td>
<td>0%</td>
</tr>
<tr>
<td>Vitamin A</td>
<td></td>
<td></td>
<td>8%</td>
</tr>
</tbody>
</table>

Not a significant source of dietary fibers, sugars, vitamin c, calcium and iron.

* Percent Daily Values are based on a 2,000 calorie diet

PLEASE DO NOT TURN THE PAGE UNTIL YOU ARE TOLD.
Answer the following questions without looking back on the previous page. Do not look back on previous page. (* = correct answer)

1) How many serving will you get out of this product before you have to but it again?
   A. 1 serving
   B. 32 servings*
   C. 10 servings
   D. 22 servings

2) This product is a source for what vitamin?
   A. Vitamin C
   B. Vitamin D
   C. Vitamin A*
   D. Vitamin E

3) How many calories does this product have per serving?
   A. 100 calories*
   B. 200 calories
   C. 50 calories
   D. 300 calories

4) What is the serving size of this product?
   A. 1 tsp.
   B. ½ tsp.
   C. 1 tbsp.*
   D. ½ tbsp

5) What percentage of calories comes from fat?
   A. 24%
   B. 50%
   C. 75%
   D. 100%*

PLEASE DO NOT TURN THE PAGE UNTIL YOU ARE TOLD.
You will have 1 minute to study Mrs. Davis’ checkbook ledger. Please study it very carefully. Do not turn the page until you are told. BEGIN STUDYING NOW.

<table>
<thead>
<tr>
<th>NUMBER</th>
<th>DATE</th>
<th>DESCRIPTION OF TRANSACTION</th>
<th>PAYMENT/DEBIT</th>
<th>DEPOSIT/CREDIT</th>
<th>BALANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4000.00</td>
</tr>
<tr>
<td>110</td>
<td>4/11</td>
<td>RENT</td>
<td>375.00</td>
<td></td>
<td>3625.00</td>
</tr>
<tr>
<td>111</td>
<td>4/12</td>
<td>DINNER</td>
<td>10.00</td>
<td></td>
<td>3615.00</td>
</tr>
<tr>
<td>112</td>
<td>4/15</td>
<td>PHONE BILL</td>
<td>75.00</td>
<td></td>
<td>3540.00</td>
</tr>
<tr>
<td>113</td>
<td>4/15</td>
<td>SOCIAL SECURITY CHECK</td>
<td></td>
<td>500.00</td>
<td>4040.00</td>
</tr>
<tr>
<td>114</td>
<td>4/20</td>
<td>CORNER MARKET</td>
<td>50.00</td>
<td></td>
<td>3990.00</td>
</tr>
</tbody>
</table>

PLEASE DO NOT TURN THE PAGE UNTIL YOU ARE TOLD.
Answer the following question without looking back on the previous page. Do not look back on previous page. (* = correct answer)

1) How much did Mrs. Davis pay for rent?
   A. $375.00*
   B. $400.00
   C. $300.00
   D. $3635.00

2) Where did Mrs. Davis but $50.00 worth of groceries?
   A. Meijer’s
   B. K-mart
   C. Farmer Jack
   D. Corner Market*

3) How much did Mrs. Davis have in her account to start off with?
   A. $3000.00
   B. $4000.00*
   C. $1000.00
   D. $500.00

4) In addition to rent, what other household/utility bill did Mrs. Davis pay?
   A. electric bill
   B. phone bill*
   C. gas bill
   D. no other bill

5) What check did Mrs. Davis deposit in her account?
   A. IRS check
   B. Check form a friend
   C. Social Security check*
   D. Did not deposit any money

PLEASE DO NOT TURN THE PAGE UNTIL YOU ARE TOLD.
Mr. Jones is 82 years old. Because of a recent health problem his family doctor prescribed the drug Captopril.

Mr. Jones medicine bottle has the following labels:

<table>
<thead>
<tr>
<th>DATE OF PRESCRIPTION: 05031096</th>
</tr>
</thead>
<tbody>
<tr>
<td>DR.: Herbst, D.E.</td>
</tr>
<tr>
<td>RX: 081224</td>
</tr>
<tr>
<td>HOWARD JONES</td>
</tr>
<tr>
<td>REFILLS: 1</td>
</tr>
<tr>
<td>EXPIRES: 08-31-97</td>
</tr>
<tr>
<td>TAKE 1 TABLE EVERY 6 HOURS (TAKE AT EVEN INTERVALS AROUND THE CLOCK)</td>
</tr>
<tr>
<td>CAPTOPRIL – 25 mg</td>
</tr>
<tr>
<td>90 TABLETS</td>
</tr>
</tbody>
</table>

TAKE MEDICATION ON AN EMPTY STOMACH
1 HOUR BEFORE OR 2 TO 3 HOURS AFTER A MEAL
UNLESS OTHERWISE DIRECTED BY YOUR DOCTOR

THIS DRUG MAY IMPAIR YOUR ABILITY TO DRIVE OR OPERATE MACHINERY, USE CARE UNTIL YOU BECOME FAMILIAR WITH ITS EFFECTS

PLEASE DO NOT TURN THE PAGE UNTIL YOU ARE TOLD.
Answer the following question without looking back on the previous page. Do not look back on previous page. (* = correct answer)

1) How often should Mr. Jones take these tablets?
   A. every 2 hours
   B. when needed
   C. every 6 hours*
   D. when he wants to

2) How long should Mr. Jones wait to eat a meal after taking a dosage?
   A. He doesn’t have to wait
   B. 6 hours
   C. 1 hour
   D. 2 hours*

3) Who is the doctor Mr. Jones should call if you have a problem with your prescription?
   A. Dr. Meyers
   B. Dr. Hebb
   C. Dr. Stevens
   D. Dr. Herbst*

4) If Mr. Jones takes this medication, what might be too impaired to do?
   A. write a letter
   B. drive a car*
   C. talk on the phone
   D. walk

5) How many pills should he take every day?
   A. 4 pills*
   B. 6 pills
   C. As many as he needs
   D. 1 pill

PLEASE DO NOT TURN THE PAGE UNTIL YOU ARE TOLD.
You have 1 minute to study the listing of Mrs. Smith are for dinner last night. Please study it very carefully. Do not turn the page until you are told. BEGIN STUDYING NOW.

Meal A:

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Carbohydrate (grams)</th>
<th>Fiber (grams)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 oz. baked chicken</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>½ cup mashed potatoes</td>
<td>15</td>
<td>1.6</td>
</tr>
<tr>
<td>½ cup green beans</td>
<td>0</td>
<td>1.2</td>
</tr>
<tr>
<td>½ cup fruit cocktail</td>
<td>15</td>
<td>1.0</td>
</tr>
<tr>
<td>1 cup 2% milk</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>42</strong></td>
<td><strong>3.8</strong></td>
</tr>
</tbody>
</table>

PLEASE DO NOT TURN THE PAGE UNTIL YOU ARE TOLD.
Answer the following questions without looking back on the previous page. Do not look back on previous page. (* = correct answer)

1) How much total fiber does the meal contain?
   A. 3.8*
   B. 1.6
   C. 4.2
   D. 3.1

2) What kind of milk did she drink with her dinner?
   A. Skim milk (0%)
   B. Low fat milk (1%)
   C. Reduced fat milk (2%)*
   D. Vitamin D milk (4%)

3) What kind of fruit did she eat?
   A. an apple
   B. a banana
   C. she didn’t eat any fruit
   D. fruit cocktail*

4) Which of the following high-carbohydrate foods did Mrs. Smith eat?
   A. rice
   B. noodles
   C. potatoes*
   D. bread

5) What kind of meat was in her meal?
   A. beef
   B. fish
   C. chicken*
   D. no meat

PLEASE DO NOT TURN THE PAGE UNTIL YOU ARE TOLD.
You will have 1 minute to study Mr. Mast’s credit card statement. Please study it very carefully. Do not turn the page until you are told. BEGIN STUDYING NOW.

<table>
<thead>
<tr>
<th>ACCOUNT NUMBER</th>
<th>PAYMENT DUE DATE</th>
<th>PAST DUE AMOUNT</th>
<th>MINIMUM PAYMENT DUE</th>
<th>BALANCE</th>
<th>AMOUNT ENCLOSED</th>
</tr>
</thead>
<tbody>
<tr>
<td>2344 2525 4654 6754</td>
<td>05/24/97</td>
<td>20.00</td>
<td>40.00</td>
<td>540.00</td>
<td>35.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DATE</th>
<th>TRANSACTIONS</th>
<th>AMOUNT (-) IS A CREDIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>04/10/97</td>
<td>SEARS</td>
<td>35.76</td>
</tr>
<tr>
<td>04/17/97</td>
<td>KMART</td>
<td>29.99</td>
</tr>
<tr>
<td>04/24/97</td>
<td>BILL KNAPP’S FAMILY RESTAURANT</td>
<td>9.50</td>
</tr>
<tr>
<td>04/30/97</td>
<td>FARMER JACK</td>
<td>45.00</td>
</tr>
</tbody>
</table>

PLEASE DO NOT TURN THE PAGE UNTIL YOU ARE TOLD.
Answer the following questions without looking back on the previous page. Do not look back on previous page. (* = correct answer)

1) How much is Mr. Mast’s credit card balance?
   A. $540.00*
   B. $600.00
   C. $100.00
   D. $50.00

2) What restaurant did Mr. Mast charge a meal at?
   A. International House of Pancakes
   B. Denney’s
   C. Bill Knapp’s Family Restaurant*
   D. He did not charge a meal

3) What store did he not use his credit care at?
   A. Farmer Jack
   B. Sears
   C. Meijer’s*
   D. K-mart

4) How much did Mr. Mast pay the credit card company this month?
   A. $20.00
   B. $35.00*
   C. $30.00
   D. $500.00

5) In what month were these purchases on this credit card statement made?
   A. December
   B. November
   C. August
   D. April*
ERB REASONING QUESTIONNAIRE

In the next questionnaire you will be presented with tables of information. You are to use these tables of information to answer questions found on the opposite page. Let’s do an example together.

EXAMPLE PROBLEM A:

Study the recipe below and answer the following questions.

<table>
<thead>
<tr>
<th>SOUR MILK BISCUITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 cups flour</td>
</tr>
<tr>
<td>3 teaspoons baking powder</td>
</tr>
<tr>
<td>1 teaspoon salt</td>
</tr>
<tr>
<td>2 tablespoons shortening</td>
</tr>
<tr>
<td>½ teaspoons soda</td>
</tr>
<tr>
<td>¾ cup sour milk</td>
</tr>
</tbody>
</table>

Sift flour, baking powder, and salt together. Rub in shortening with finger tips. Mix soda and sour milk. Add slowly to first mixture and mix to a soft dough. Roll out on a slightly floured board to ½ inch thickness. Cut with a biscuit cutter. Bake in quick oven (450 degree) 10 to 15 minutes.

Yield: 12 biscuits.

1) Which ingredient is mixed with sour milk?

The correct answer to problem 1 is “soda”. The instruction say to mix “soda” and “sour milk” together. Does anyone have any questions? Let’s turn the page and begin now.

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*correct answers are highlighted in yellow.*
In the chart below you will see two drugs listed “Drug 1” and “Drug 2”. The third column tells you what will happen if you take these two medications at the same time. Use the chart below to answer the questions on the opposite page.

<table>
<thead>
<tr>
<th>Drug 1</th>
<th>Drug 2</th>
<th>Possible side effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lanoxin (heart pill)</td>
<td>Lasix (water pill)</td>
<td>rash, vomiting, headache, irregular heartbeat, fever</td>
</tr>
<tr>
<td>Capoten (blood pressure pill)</td>
<td>Lasix (water pill)</td>
<td>rash, nausea, irregular heartbeat</td>
</tr>
<tr>
<td>Capoten (blood pressure pill)</td>
<td>Genuine Bayer Aspirin (pain reliever)</td>
<td>chest pain, vomiting, nausea</td>
</tr>
<tr>
<td>Genuine Bayer Aspirin (pain reliever)</td>
<td>Maalox (antacid)</td>
<td>fever, confusion, headache</td>
</tr>
</tbody>
</table>
1) What kind of pill is Lasix?
   water pill

2) Name two side effects listed for Aspirin and Maalox?
   Any combination of these: fever, confusion, headache

3) Name one of the medications under the heading of Drug 1.
   Any combination of: lanoxin, capoten, genuine bayer aspirin

4) Mr. Albert takes two medications at 5 pm. One of the medications was taken because of a severe headache. Twenty minute later John begins to feel extremely nauseous. Which combination of drugs did John take?
   Genuine Bayer Aspirin and capoten

5) One drug, taken in combination with several other medications, often causes an irregular heartbeat. Which drug might this be?
   Lasix

6) When you take Bayer and Maalox, what possible side effect could you get that is different from any other symptoms listed in the chart?
   confusion

7) If Mr. Albert is taking Capoten for high blood pressure should he take Aspirin at the same time?
   No
Below is a recent chart detailing the benefits offered by Medicare. Use the information below to answer the questions on the opposite page.

### MEDICARE (PART A): HOSPITAL INSURANCE COVERED SERVICES FOR 1996

<table>
<thead>
<tr>
<th>Services</th>
<th>Benefit</th>
<th>Medicare Pays</th>
<th>You Pay</th>
</tr>
</thead>
<tbody>
<tr>
<td>HOSPITALIZATION</td>
<td>First 60 days</td>
<td>All but $736</td>
<td>$736</td>
</tr>
<tr>
<td>Semiprivate room and board, general nursing and other hospital services and supplies</td>
<td>61st to 90th day</td>
<td>All but $186 a day</td>
<td>$184 a day</td>
</tr>
<tr>
<td></td>
<td>91st to 150th day</td>
<td>All but $368 a day</td>
<td>$368 a day</td>
</tr>
<tr>
<td></td>
<td>Beyond 150 days</td>
<td>Nothing</td>
<td>All costs</td>
</tr>
<tr>
<td>SKILLED NURSING FACILITY CARE</td>
<td>First 20 days</td>
<td>100% approved amount</td>
<td>Nothing</td>
</tr>
<tr>
<td>Semiprivate room and board, general nursing and other hospital services and supplies **</td>
<td>Additional 80 days</td>
<td>All but $92 a day</td>
<td>Up to $92 a day</td>
</tr>
<tr>
<td>HOME HEALTH CARE</td>
<td>Unlimited as long as you meet Medicare requirements for home health care benefits.</td>
<td>80% of approved amount of durable medical equipment.</td>
<td>Nothing for services; 20% of approved amount for durable medical equipment.</td>
</tr>
<tr>
<td>Part-time or intermittent skilled care, home health aide services, durable medical equipment and supplies and other services</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HOSPICE CARE</td>
<td>For as long as doctor certifies need.</td>
<td>All but limited costs for outpatient drugs and inpatient respite care.</td>
<td>Limited cost sharing for outpatient drugs and inpatient respite care.</td>
</tr>
<tr>
<td>Pain relief, symptom management and support services for the terminally ill.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BLOOD</td>
<td>Unlimited during a benefit period if medically necessary.</td>
<td>All but first 3 pints per calendar year.</td>
<td>For first 3 pints.***</td>
</tr>
<tr>
<td>When furnished by a hospital or skilled nursing facility during a covered stay.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* 60 reserve days may be used only once

** Neither Medicare nor Medigap insurance will pay for most nursing home care

***To the extent the three pints of blood are paid for or replaced under one part of Medicare during the calendar years, they do not have to be pair for or replaced under the other part.
1) What is the name of the insurance described in the above chart?
   Medicare Part A

2) Does this insurance cover hospitalization?
   Yes

3) Does this insurance cover home health care aides?
   Yes

4) If you had a very serious illness, so that you had to stay in the hospital for a long time, how much would you have to pay in starting on the 91st day?
   $368 a day

5) If you are approved, how much do you have to pay for medical equipment such as a wheelchair or walker?
   20% of cost

6) If you receive hospice care, what do you have to help pay for?
   Outpatient drug and inpatient respite care

7) As you move into a sixth month in the hospital how much of the costs do you have to pay?
   All costs
Mr. Cole is taking the three medications listed below. On Sunday night, he decides that he is going to put all his pills for the week into a pill box that is divided into chambers for morning, noon, evening, and bedtime, for every day of the week. Use the labels below to answer the questions on the opposite page.

<table>
<thead>
<tr>
<th>DATE OF PRESCRIPTION: 05-31-97</th>
<th>RX: 081221</th>
</tr>
</thead>
<tbody>
<tr>
<td>DR.: SNOW, J.R.</td>
<td></td>
</tr>
<tr>
<td>JOHN COLE</td>
<td>REFILLS: 1</td>
</tr>
<tr>
<td>EXPIRES: 08-19-97</td>
<td></td>
</tr>
<tr>
<td>TAKE 1 CAPSULE ON MONDAY, WEDNESDAY, AND FRIDAY AT BREAKFAST</td>
<td></td>
</tr>
<tr>
<td>LANOXIN – 0.125 mg</td>
<td>60 CAPSULES</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DATE OF PRESCRIPTION: 05-31-97</th>
<th>RX: 081222</th>
</tr>
</thead>
<tbody>
<tr>
<td>DR.: SNOW, J.R.</td>
<td></td>
</tr>
<tr>
<td>JOHN COLE</td>
<td>REFILLS: 1</td>
</tr>
<tr>
<td>EXPIRES: 08-21-97</td>
<td></td>
</tr>
<tr>
<td>TAKE DAILY WITH MEALS AND AT BEDTIME</td>
<td></td>
</tr>
<tr>
<td>VASOTEC – 10 mg</td>
<td>60 CAPSULES</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DATE OF PRESCRIPTION: 05-31-97</th>
<th>RX: 081223</th>
</tr>
</thead>
<tbody>
<tr>
<td>DR.: SNOW, J.R.</td>
<td></td>
</tr>
<tr>
<td>JOHN COLE</td>
<td>REFILLS: 1</td>
</tr>
<tr>
<td>EXPIRES: 09-31-97</td>
<td></td>
</tr>
<tr>
<td>TAKE DAILY, EVERY MORNING AND BEFORE BED</td>
<td></td>
</tr>
<tr>
<td>PRINIVIL – 5 mg</td>
<td>60 CAPSULES</td>
</tr>
</tbody>
</table>
1) Name the doctor who prescribed these three medications.
   ____________________________
   Snow

2) What is the patient’s first name?
   ____________________________
   John

3) How many different medication is the patient taking?
   ____________________________
   Three

4) How many pills should be in the Wednesday chamber?
   ____________________________
   Seven

5) How many pills will Mr. Cole take every night before he goes to bed?
   ____________________________
   Two

6) What is the total number of pills Mr. Cole should take on Saturday?
   ____________________________
   Six

7) By 2:00 pm on Tuesday, how many pills should Mr. Cole have taken for the day?
   ____________________________
   Three
Mr. Alvarez just recently retired and is looking to open a new checking account. He went to his local bank, and got some information on the different checking accounts offered. Above is a comparison of the three different accounts his bank offers. Use the information below to answer the questions on the opposite page.

<table>
<thead>
<tr>
<th>Checking Account</th>
<th>Monthly maintenance fee</th>
<th>Charge for each check</th>
<th>Charge for each electronic debit</th>
<th>Minimum checking balance</th>
<th>Interest earned</th>
<th>Waivable fees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic checking</td>
<td>$3.00</td>
<td>$.40 for each check</td>
<td>No charge</td>
<td>Not required</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Regular checking</td>
<td>$5.50 with check return</td>
<td>$.40</td>
<td>$.40</td>
<td>$500.00</td>
<td>N/A</td>
<td>All fees waived with $1,000 minimum balance</td>
</tr>
<tr>
<td>Interest Plus Checking</td>
<td>$9.00 with check return</td>
<td>$.40</td>
<td>$.40</td>
<td>$1000.00</td>
<td>2.0%</td>
<td>All fees waived with $5,000 minimum balance</td>
</tr>
</tbody>
</table>
1) What kind of bank account does this chart deal with?
   Checking

2) What is the largest dollar amount under the Minimum checking balance heading?
   $1000.00

3) What is the highest interest rate one can earn according to this chart?
   2.0%

4) Mr. Alvarez only writes at the most 5 checks a month, which checking account would be the best for him?
   Basic Checking

5) If Mr. Alvarez planned to use electronic debit a great deal, and could not keep a minimum balance of more then 600.00 dollars, which checking account would he want?
   Regular Checking

6) On which checking account can Mr. Alvarez earn money?
   Interest Plus Checking

7) If Mr. Alvarez has a regular checking account and a $9997.00 balance, what are his fees if he writes 3 checks and uses the ATM 2 times in a particular month? $7.50 (monthly maintenance fee + charge 3 checks + 2 ATM transactions)
Miss Baum wants a can of chili as part of her dinner. She goes to her cabinet and finds two different cans of chili. The labels for both cans are displayed below. Based on the information found in these labels answer the questions on the opposite page.

### Chili
#### BRAND A

Nutrition Facts
Serving Size 1 cup (236 g)
Servings Per Container about 2

<table>
<thead>
<tr>
<th>Amount Per Serving</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories</td>
<td>410</td>
<td>Calories from Fat</td>
</tr>
<tr>
<td>% Daily Values</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Fat</td>
<td>30 g</td>
<td>46%</td>
</tr>
<tr>
<td>Saturated Fat</td>
<td>13 g</td>
<td>61%</td>
</tr>
<tr>
<td>Cholesterol</td>
<td>75 mg</td>
<td>25%</td>
</tr>
<tr>
<td>Sodium</td>
<td>950 mg</td>
<td>39%</td>
</tr>
<tr>
<td>Total Carbohydrate</td>
<td>16 g</td>
<td>5%</td>
</tr>
<tr>
<td>Dietary Fiber</td>
<td>4 g</td>
<td>14%</td>
</tr>
<tr>
<td>Sugars</td>
<td>4 g</td>
<td></td>
</tr>
<tr>
<td>Proteins</td>
<td>20 g</td>
<td></td>
</tr>
<tr>
<td>Vitamin A</td>
<td>26%</td>
<td></td>
</tr>
<tr>
<td>Calcium</td>
<td>4%</td>
<td></td>
</tr>
</tbody>
</table>
| *Percent Daily values are based on a 2,000 calorie diet

### Chili
#### BRAND B

Nutrition Facts
Serving Size 1 cup (236 g)
Servings Per Container about 2

<table>
<thead>
<tr>
<th>Amount Per Serving</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories</td>
<td>190</td>
<td>Calories from Fat</td>
</tr>
<tr>
<td>% Daily Values</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Fat</td>
<td>3 g</td>
<td>5%</td>
</tr>
<tr>
<td>Saturated Fat</td>
<td>1 g</td>
<td>5%</td>
</tr>
<tr>
<td>Cholesterol</td>
<td>75 mg</td>
<td>25%</td>
</tr>
<tr>
<td>Sodium</td>
<td>1250 mg</td>
<td>52%</td>
</tr>
<tr>
<td>Total Carbohydrate</td>
<td>17 g</td>
<td>6%</td>
</tr>
<tr>
<td>Dietary Fiber</td>
<td>3 g</td>
<td>12%</td>
</tr>
<tr>
<td>Sugars</td>
<td>3 g</td>
<td></td>
</tr>
<tr>
<td>Proteins</td>
<td>19 g</td>
<td></td>
</tr>
<tr>
<td>Vitamin A</td>
<td>25%</td>
<td></td>
</tr>
<tr>
<td>Calcium</td>
<td>3%</td>
<td></td>
</tr>
</tbody>
</table>
| *Percent Daily values are based on a 2,000 calorie diet
1) What product are these nutrition labels for?
   _Chili_ 

2) What is the serving size of Brand A?
   _1 cup_ 

3) How many mg. of sodium is in Brand B?
   _1250 mg_ 

4) Miss Baum needs to avoid foods that are high in fat, which can of chili would she be more likely to eat?
   _Brand B_ 

5) If she selects Brand B, which categories will she get more of?
   _sodium and total carbohydrate_ 

6) Which category does both cans of chili have the exact amount of?
   _cholesterol and vitamin C_ 

7) If she wanted to cut down on her intake of salt, which can of chili would she want to avoid?
   _Brand B_
Below you see what Mrs. Carver ate for the entire day in the first column. In the second column is a list of the number of servings Mrs. Carver had for each food group. Use this list and the food pyramid below to answer the following questions.

<table>
<thead>
<tr>
<th>FOOD GROUP</th>
<th>BREAKFAST SERVINGS</th>
<th>LUNCH SERVINGS</th>
<th>DINNER SERVINGS</th>
<th>SNACKS SERVINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bread, Cereal, Rice &amp; Pasta Group</td>
<td>2 pancakes</td>
<td>2 Slices of cheese pizza</td>
<td>1 Whole wheat roll</td>
<td>1 candy bar</td>
</tr>
<tr>
<td>Meat, Poultry, Fish, Dry Beans, Eggs &amp; Nuts Group</td>
<td>4 oz. orange juice</td>
<td>8 oz coke</td>
<td>6 oz. broiled steak</td>
<td>1 apple</td>
</tr>
<tr>
<td>Vegetables Group</td>
<td>½ grapefruit</td>
<td>1 cup of mixed greens</td>
<td>1 cup of salad</td>
<td>1 cup of popcorn</td>
</tr>
<tr>
<td>Fruit Group</td>
<td>1 bread and 1 fat</td>
<td>2 breads, 2 milks, ½ vegetable</td>
<td>1 bread</td>
<td>fats and sweets</td>
</tr>
<tr>
<td>Milk, Yogurt &amp; Cheese Group</td>
<td>1 fruit</td>
<td>sweets</td>
<td>2 protein</td>
<td>1 fruit</td>
</tr>
<tr>
<td>Fats, Oils &amp; Sweets</td>
<td>1 fruit</td>
<td></td>
<td>1 vegetable</td>
<td></td>
</tr>
<tr>
<td>USE SPARINGLY</td>
<td></td>
<td></td>
<td>2 vegetables</td>
<td>1 bread</td>
</tr>
</tbody>
</table>
1) Name three of the foods on this food list from the bread and cereals food group. 
   Any combination of these: pancakes, wheat roll, popcorn, pizza

2) Name one of the foods that was eaten as a snack. 
   Any of these: candy bar, apple, popcorn

3) Across the food groups, how many total servings did Mrs. Carver eat for dinner? 
   16.5 servings

4) Looking at what Mrs. Carver ate for the entire day, what food group did she not 
   eat enough of? 
   Breads and cereals

5) How many bread servings did Mrs. Carver eat for the entire day? 
   4

6) According to the food pyramid how many more fruits and meat servings does she 
   need to eat today? 
   None

7) According to the food pyramid, which food group did she too much of today? 
   Sweets & Fats
Short Version of the Test of Functional Health Literacy in Adults (S-TOFHLA)
Read each text box and then answer the question directly after it by filling in the blank

Jean Lindley
Dr. Miller
Tylenol ES.
Take one tablet by mouth every 6 hours as needed.

1) If you take your first table at 7:00 am, when should you take the next one?
   1 PM

Normal blood sugar is 60-150. Your blood sugar today is 160.

2) If this were your score, would your blood sugar be normal today?
   No

Clinic Appointment
Clinic: Diabetic   Location: 3\textsuperscript{rd} floor
Day: Thursday   Date: April 2   Hour: 10:20 am
Issued by: Dr. Miller
You must bring your plastic card with you

3) When is your next appointment? Thursday, April 2 at 10:20 am

Jean Lindley
Dr. Miller
Tylenol ES.
Take medication on empty stomach one hour before or two to three hours after a meal unless otherwise directed by your doctor.

4) If you eat lunch at 12:00 noon, and your want to take this medicine before lunch, what time should you take it?
   11:00 am or between 2:00-3:00 PM
Select the best term to fill in each blank within the following sentences.

5) Your doctor has sent you to have a __A__ X-ray. The x-ray will __A__ from 1 to 3 __C__ to do.

<table>
<thead>
<tr>
<th></th>
<th>a. Stomach</th>
<th>b. Diabetes brains</th>
<th>c. Stitches</th>
<th>d. germs</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>take</td>
<td>view</td>
<td>talk</td>
<td>look</td>
</tr>
<tr>
<td>b.</td>
<td>take</td>
<td>view</td>
<td>talk</td>
<td>look</td>
</tr>
<tr>
<td>c.</td>
<td>take</td>
<td>view</td>
<td>talk</td>
<td>look</td>
</tr>
<tr>
<td>d.</td>
<td>take</td>
<td>view</td>
<td>talk</td>
<td>look</td>
</tr>
</tbody>
</table>

The day before the x-ray for supper have only a __A__ snack of fruit, __C__ and jelly, with coffee or tea.

<table>
<thead>
<tr>
<th></th>
<th>a. little</th>
<th>b. broth</th>
<th>c. attack</th>
<th>d. nausea</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>toes</td>
<td>throat</td>
<td>toast</td>
<td>thin</td>
</tr>
<tr>
<td>b.</td>
<td>toes</td>
<td>throat</td>
<td>toast</td>
<td>thin</td>
</tr>
<tr>
<td>c.</td>
<td>toes</td>
<td>throat</td>
<td>toast</td>
<td>thin</td>
</tr>
<tr>
<td>d.</td>
<td>toes</td>
<td>throat</td>
<td>toast</td>
<td>thin</td>
</tr>
</tbody>
</table>
MDRTC Brief Diabetes Knowledge Test (* = correct answer)

1) The diabetes diet is:
   a. the way most American people eat
   b. a healthy diet for most people*
   c. too high in carbohydrate for most people
d. too high in protein for most people

2) Which of the following is highest in carbohydrate?
   a. Baked chicken
   b. Swiss cheese
   c. Baked potato*
d. Peanut butter

3) Which of the following is highest in fat?
   a. Low fat milk?*
   b. Orange juice
c. Corn
d. Honey

4) Which of the following is a “free food”?
   a) Any unsweetened food
   b) Any dietetic food
c. Any food that says “Sugar Free” on the label
d) Any food that has less than 20 calories per serving*

5) Glycosylated hemoglobin (hemoglobin A1c) is a test that is a measure of your 
average blood glucose for the past: 
   a) day
   b) week
c) 6-10 weeks*
d) 6 months

6) Which is the best method for testing blood glucose?
   a) Urine testing
   b) Blood testing*
c) Both are equally good

7) What effect does unsweetened fruit juice have on blood glucose?
   a) Lowers it
   b) Raises it *
c) Has no effect
8) Which should not be used to treat low blood glucose?
   a) 3 hard candies
   b) ½ cup orange juice
   c) 1 cup diet soft drink*
   d) 1 cup skin milk

9) For a person in good control, what effect does exercise have on blood glucose?
   a) Lowers it*
   b) Raises it
   c) has no effect

10) Infection is likely to cause:
    a) an increase in blood glucose*
    b) a decrease in blood glucose
    c) no change in blood glucose

11) The best way to take care of your feet is to:
    a) look at and wash them each day*
    b) massage them with alcohol each day
    c) soak them for one hour each day
    d) buy shoes a size larger than usual

12) Eating food lower in fat decreases your risk for:
    a) nerve disease
    b) kidney disease
    c) heart disease*
    d) eye disease

13) Numbness and tingling may be symptoms of:
    a) kidney disease
    b) nerve disease*
    c) eye disease
    d) liver disease

14) Which of the following is usually not associated with diabetes:
    a) vision problems
    b) kidney problems
    c) nerve problems
    d) lung problems*
15) Signs of ketoacidosis include:
   a) shakiness
   b) sweating
   c) vomiting*
   d) low blood glucose

16) If you are sick with the flu, which of the following changes should you make?
   a) take less insulin
   b) drink less liquids
   c) eat more proteins
   d) test for glucose and ketones more often*

17) If you have taken intermediate-acting insulin (NPH or Lente), you are most likely to have an insulin reaction in:
   a) 1-3 hours
   b) 6-12 hours *
   c) 12-15 hours
   d) more than 15 hours

18) You realize just before lunchtime that you forgot to take your insulin before breakfast. What should you do now?
   a) Skip lunch to lower your blood glucose.
   b) Take the insulin that you usually take at breakfast
   c) Take twice as much insulin as your usually take at breakfast
   d) Check your blood glucose level to decide how much insulin to take*

19) If you are beginning to have an insulin reaction, you should:
   a) exercise
   b) lie down and rest
   c) drink some juice*
   d) take regular insulin

20) Low blood glucose may be caused by:
   a) too much insulin*
   b) too little insulin
   c) too much food
   d) too little exercise
21) If you take your morning insulin but skip breakfast your blood glucose level will usually:
   a) increase
   b) decrease*
   c) remain the same

22) High blood glucose may be caused by:
   a) not enough insulin*
   b) skipping meals
   c) delaying your snack
   d) large ketones in your urine

23) Which one of the following will most likely cause an insulin reaction:
   a) heavy exercise*
   b) infection
   c) overeating
   d) not taking your insulin
REFERENCES


Max, M. (1996). Johnny can’t read the medicine bottle. *American Journal of Medicine, 100*(2), II.


