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**PSYCHOMETRIC CHARACTERISTICS OF TWO HEALTH
MEASURES IN RELATION TO OLDER ADULTS'
COGNITIVE FUNCTION: A SECONDARY ANALYSIS**

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by

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Dedication

I dedicate this dissertation to my family.

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The older population of the U.S. and the world is growing rapidly, and these large numbers will represent a major challenge for society in general and the health care system in particular. Deteriorating health and cognitive function are the two primary concerns faced by older adults. Therefore, it is important to understand how these two concerns are related to in the elderly aged 65 or older. This secondary analysis has two purposes. The first is to investigate the relationship between older adults' health status and cognitive function. The second is to examine the psychometric characteristics of two health measures in relation to older adults' cognitive function.

Health status was measured with the Medical Outcomes Study Short Form 36-item Health Survey (SF-36) and the Medical Outcomes Study Short Form 12-

item Health Survey (SF-12). Cognitive function was evaluated in three domains of cognition, memory performance, and metamemory. Cognition was measured with the Mini-Mental State Examination, and memory performance was tested with the Rivermead Behavioural Memory Test. Metamemory was measured with the seven subscales of the Metamemory in Adulthood questionnaire.

Criteria for study participants were that they be 65 years old or older, Caucasian or African-American, able to read and speak English as a primary language, and without cognitive impairment. A total of 231 subjects participated in the study. The sample consisted of 70% females and 30% males, and almost half of the subjects in the sample were African-Americans. Participants' age ranged from 66 to 97 ($M = 77.72$, $SD = 6.42$), and level of education ranged from 3 to 25 years ($M = 12.22$, $SD = 3.44$).

Older participants tended to have lower scores on the summary measures of physical health, cognition, memory performance, and Change (worsening). Participants' education was moderately correlated with everyday memory performance, Task, and Strategy. The findings indicate that some aspects of health status are modestly associated with older adults' cognitive function. In addition, the findings suggest that SF-12 evaluated the health status and the cognitive function of the study sample as well as SF-36. Discussions of the findings, limitations, and recommendations are presented.

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CHAPTER 1: INTRODUCTION

The burgeoning older adult population in the United States and throughout the world represents a profound challenge to these societies and their health care systems. Deteriorating health and cognitive functions are major concerns for the elderly population. This secondary analysis investigates the associations between older adults' health status and cognitive function. This study also seeks to understand the extent to which the association can be found when health status is measured by two different versions of a health status measure, each with its respective number of items. This first chapter outlines the purpose of the study, its importance, the research questions, theoretical frameworks, definitions of terms, assumptions, and the limitations associated with the current study.

PURPOSE

The purpose of this study is twofold. The first purpose is to examine the relationship of subjectively perceived health status with cognitive function in the elderly, aged 65 or older. The second is to compare between the Medical Outcomes Study Short Form 36-item Health Survey (SF-36) and the Medical Outcomes Study Short Form 12-item Health Survey (SF-12) the extent to which they are useful in explaining the relationship between health status and cognitive function among the elderly.

Age-related decline in memory is the most frequent cognitive complaint of the elderly (Bassett & Folstein, 1993; Dixon & Hultsch, 1983a; Fisher, 1991; Gagnon et al., 1994; Herzog & Rodgers, 1989; Jonker, Launer, Hooijer, &

Lindeboom, 1996; Zelinski, Gilewski, & Thompson, 1980). Memory is an essential aspect of cognitive function (McDougall, 1990), and memory deterioration is the most frequent and the earliest sign of cognitive impairment. Older people's complaints about their failing memories must be taken seriously, especially since they are significantly associated with poor performance on cognitive measures (Turvey, Schultz, Arndt, Wallace, & Herzog, 2000). One especially important factor associated with the deterioration of memory performance is the status of health in the elderly. This comes as no surprise, of course, since as people grow older they tend to have more health problems. There have been efforts, therefore, to pinpoint the precise link between health and cognitive function, especially with respect to memory, among the elderly. Studies have resulted in inconsistent results, however, in explaining the precise nature of the association between health status and cognitive function. Some of these inconsistencies can be attributed to issues related to the measurement of both health status and cognitive function. This study, therefore, measures both health status and cognitive function with instruments which take these issues into account.

There are two broad issues to discuss regarding the measurement process of health status in cognitive studies. First, health status has generally been conceptualized within the disease-oriented perspective and measured objectively. Frequently measured objective health indices, such as the kinds of diseases diagnosed, types of medications taken, days of hospitalization, etc., have often failed to accurately represent an individual's full or accurate state of health. As a

result of the typical aging processes, older adults often have several simultaneous comorbid afflictions; yet, these conditions and their respective treatments do not usually have an impact on the cognitive functions of these older adults (Schaie, 1994). Second, less frequently measured, subjective perceptions of health have generally been assessed with a single-item scale. While a single-item health scale may be convenient, it is a very crude way to seek to understand the highly complicated nature of an individual's health status (Salthouse, Kausler, & Sauls, 1990).

While researchers are becoming increasingly aware of the importance of investigating subjectively perceived health status in studies of age-related memory decline among the elderly, progress has been hampered by the lack of appropriate measures of health status (Ware & Sherbourne, 1992). When older adults are asked to evaluate their own health, certain characteristics make an accurate assessment of health difficult. For example, the length of a test is critical for older adults. A questionnaire may seem a modest number of items to a respondent who is young and in good health could well represent a considerable burden for an older adult who often requires considerably more time to read and to digest a question and then to formulate an adequate response. In one study, as subjects' age was increased, the response rate was decreased, and so was the rate of completing questionnaires sufficiently enough to compute valid scale scores (McHorney, 1996). Disabled older adults such as hospital inpatients respond less reliably even when they do not suffer from a cognitive impairment (Fowler, Congdon, & Hamilton, 2000; Parker, Peet, Jagger, Farhan, & Castleden, 1998).

Ideally, health questionnaires administered to older adults should be simple to understand and as brief as possible, yet still valid and reliable.

This study measures older adults' health status with the Medical Outcomes Study Short Form 36-item Health Survey (SF-36), which produces a complete picture of an individual's health experience as a result of using either eight health profile or two summary measures. Even though the SF-36 is a popular generic health measure, only a few studies have investigated the relationship between health status, as measured with the SF-36, and cognitive function among the elderly (Marri et al., 2001).

The SF-12 is the shorter version of the SF-36 (Ware, Kosinski, & Keller, 1996). No study has been found that compared the SF-36 and the SF-12 in relation to cognitive functioning in the elderly. If the relationship between health status and cognitive function in the elderly can be successfully explained with SF-12 as effectively as with SF-36, without compromising the psychometric properties, SF-12 could be a better choice of health measure in studies on older adults' cognitive functioning.

This study also addresses measurement issues in assessing cognitive function. The strongest criticism of previous cognitive aging studies has resulted from the method used to measure cognitive function. Most studies were conducted in laboratory settings, and, therefore, cognitive performance was assessed with measures which were not necessarily related to everyday tasks, or adequate in terms of ecological validity. More specifically, memory performance was evaluated with measures which have low levels of ecological validity, which

were not useful for solving memory problems occurring in everyday life. To be useful, memory measures need to deal with and fully take into account natural environments. This study investigates the relationship between health status and cognitive function among the community-living elderly, aged 65 or older. The two constructs are measured with instruments that have been chosen to overcome criticisms related to specific measurement issues. This study also aims to compare the performances of two health measures in explaining cognitive function in the elderly.

BACKGROUND AND SIGNIFICANCE

Aging Population

The elderly population in the world, as well as in the U.S. has been rapidly increasing. Both the number and proportion of older people relative to the number of the total population is increasing. According to the U.S. Census Bureau (Taeuber, 1996), during the period from 1995 to 2030, the number of Americans, aged 65 or older, is expected to double from approximately 33.5 million in 1995, to 69.4 million in 2030. The number of older Americans will continue to grow as the baby boom generation grows older and as they continue to enjoy longer and healthier lives. Over the course of the next 30 years, the proportion of the elderly will reach 20 percent of the total population. This means that one out of five people would be 65-year old or older. Moreover, the elderly population aged 85 or older is expected to grow faster than any other age groups (Federal Interagency Forum on Aging-Related Statistics, 2000).

These changes in population demographics underscore the importance of studying older adults' cognitive function, especially memory. To live and function independently in a community situation, adequate memory function is an essential requirement for older people (Ferrucci et al., 1993; Sands et al., 2002). Memory deterioration is the earliest and most frequent symptom of cognitive impairments such as Alzheimer's disease (AD). An individual often complains of memory problems before being diagnosed with AD and the individual is considered as having mild cognitive impairment (Honig & Mayeux, 2001). As such, older adults' memory complaints reflect much more than negative opinions or complaints, but might be an important sign of further deterioration and impending cognitive problems. In the literature on cognitive functioning among the elderly, memory is the factor that is most frequently studied since, even for most older adults that are in good physical condition, cognitive deterioration could threaten their ability to continue to fully enjoy social activities. For the elderly with physical limitations, in particular, memory decline represents an additional threat to the quality of life that they wish to enjoy (National Research Council, 2000).

Deteriorating health and cognition among the elderly are the two major constructs lead to increased dependency. Loen (1991) found that, among the various risk factors associated with dependency, as measured by the Instrumental Activities of Daily Living scale (IADLs), cognitive impairment and lower functional status were the two factors that best served to predict a high dependency level. Thus far very few studies on memory have been conducted by nurse researchers even though age-related memory complaints and memory

disorders are issues that are perhaps the most commonly reported during the nursing care given to elderly persons (McDougall, 1999).

Aging and Healthcare Needs

In terms of health services, the older adult population suffers from a higher level of illness and disability which represents a great burden and challenge for our health care system. About 88 percent of the elderly aged 65 and older suffer from at least one chronic condition, and 50 percent of them have at least two, based on data from the 1987 National Medical Expenditure Survey that examined prevalence and direct health care costs (Hoffman, Rice, & Sung, 1996). In 1995, 58 percent of the elderly 70 years of age and older reported having arthritis, 45 percent reported having hypertension, and 21 percent reported having heart disease (Federal Interagency Forum on Aging-Related Statistics, 2000). Chronic diseases contribute to increasing health care costs. In 1995, adults aged 65 or older spent \$310 billion, which is about 35 percent of personal health care expenditures in the U.S. (Desai, Zhang, & Hennessy, 1999). If the current level of disease prevalence remains the same in 2030, the U.S. health care system will need to spend an additional \$400 to \$500 billion a year on the elderly population alone (National Center for Chronic Disease Prevention and Health Promotion, 1999).

Although older Americans are healthier than ever before, there are still millions of older adults who must rely upon others to help them with the activities of daily living, even though they may not be physically ill, or even suffer from memory problems or, in a broader sense, cognitive impairment. In 1998, the

percentage of older Americans with moderate to severe memory impairments ranged from about 4 percent among persons 65 to 69, to about 30 percent among persons 85 or older (Federal Interagency Forum on Aging-Related Statistics, 2000).

The incidence of cognitive impairments such as dementia is very high among the elderly, and it is expected to increase significantly (Evans et al., 1989; Schneider & Guralnik, 1990). In 1999, 4 million people in the U.S. had Alzheimer's disease (AD), which is the principal cause of dementia among the elderly. Over the next 50 years, the prevalence is expected to increase to 14.3 million (National Institute on Aging, 1999). This projection indicates that one out of every 45 Americans will have the disease (Brookmeyer, Gray, & Kawas, 1998). The prevalence of AD increases drastically with age. It is estimated that only 3.0 percent of people, aged 65 to 74, are affected with AD. By ages 75 to 84, the prevalence increases to 18.7 percent and then 47.2 percent for those 85 or older (Bachman et al., 1993; Hebert et al., 1995; Kokmen, Chandra, & Schoenberg, 1988).

Caring for patients with Alzheimer's disease is especially costly (Ernst & Hay, 1994). The indirect care costs, such as unpaid care provided by the family and lost productivity among caregivers, are expected to be much higher than medical costs (Small, McDonnell, Brooks, & Papadopoulos, 2002). The total direct cost of caring for an Alzheimer's patient for 6 months is \$3,129 compared to the total indirect cost of \$26,080. Estimated annual health care expenses resulting from Alzheimer's disease in the U.S., including both direct and indirect

costs, are \$80 to \$100 billion (National Center for Chronic Disease Prevention and Health Promotion, 1999).

Health and Age-related Cognitive Changes

As suggested above, the high prevalence of cognitive impairments among the elderly is a great challenge to our aging society. Caring for the impaired elderly requires a major investment of personal, financial, and community resources. Accurate assessment of the cognitive functioning of the elderly is, therefore, of especially great importance. Assessed cognitive problems may represent early stages of Alzheimer's disease (Morris et al., 2001), or may indicate the need for more sensitive diagnostic tests to verify the presence of organic diseases in the brain (Crum, Anthony, Bassett, & Folstein, 1993; Folstein, 1983). The assessed cognitive problems may help to maintain or promote older adults' cognitive function through training and thereby assist them to live independently (Floyd & Scorgin, 1997). As such, the early detection of cognitive deterioration is especially important since the assessment may assist nurses to plan appropriate interventions to help the elderly to be able to continue living independently in their communities (McDougall, 1991).

It is commonly believed that memory inevitably deteriorates as people age, but the actual deterioration may not occur as frequently as we might have previously thought (Fisher, 1991). Each individual has a different trajectory of declining memory, depending on various factors, particularly health status.

Few studies have shown that health status in the elderly is strongly associated with cognitive function (Cutler & Grams, 1988; Perlmutter & Nyquist,

1990). One possible reason for the failure to demonstrate and verify this relationship is related to the issues surrounding measurements of health status and cognitive function. The current study attempts to examine the association between health status and cognitive function in the elderly while taking into account those measurement issues. It is believed that a multidimensional health evaluation produces more information about older adults' health experiences than the health assessed with a single-item scale or objective indices.

The ability to replicate scores of the two summary measures from SF-36 by the two summary measures from SF-12 without suffering any substantial loss of information has been established in studies with a variety of samples: a group of adults from general U.S. population (Ware, Kosinski, & Keller, 1995), stroke patients (O'Mahony, Rodgers, Thomson, Dobson, & James, 1998; Pickard, Johnson, Penn, Lau, & Noseworthy, 1999), patients suffering from Rheumatoid Arthritis (Hurst, Ruta, & Kind, 1998), patients with multiple sclerosis (Nortvedt, Riise, Myhr, & Nyland, 2000), and patients with various diagnoses (Jenkinson et al., 1997). However, no study has yet compared the psychometric properties of SF-36 and SF-12 by using both instruments to predict cognitive function among community-living older adults. Furthermore, the precise extent to which instrument is useful as a predictive measure of cognitive function in the elderly is yet to be determined. The current study will help ascertain which aspects of health status are related to cognitive function among those 65-year old or older.

RESEARCH QUESTIONS

The research questions stated below will guide the current study.

1. What is the range of health status, cognition, memory performance, and metamemory among the elderly, those 65 or older?
2. Does health status vary as a function of measures, when health status in the elderly is assessed with SF-36 and SF-12?
3. What are the relationships between health status and cognitive functions, such as cognition, memory performance, and metamemory among the elderly, those 65 or older?
4. Which health status measures (SF-36 vs. SF-12) predict cognitive functions, such as cognition, memory performance, and metamemory in the elderly, those 65 or older?
5. When controlling for age, which health status measures (SF-36 vs. SF-12) predict cognitive functions, such as cognition, memory performance, and metamemory in the elderly, those 65 or older?

THEORETICAL FRAMEWORKS

Several theoretical frameworks serve as a foundation for the current investigation: environmental changes, conceptualization of health, and psychometric theories. This section briefly introduces each theoretical framework. Details of each framework will be discussed later in the review of literature.

The framework of environmental changes (Salthouse, 1991, 1999) supports this examination of subjective perception of health in relation to cognitive functioning in older adults. Environmental changes framework proposes

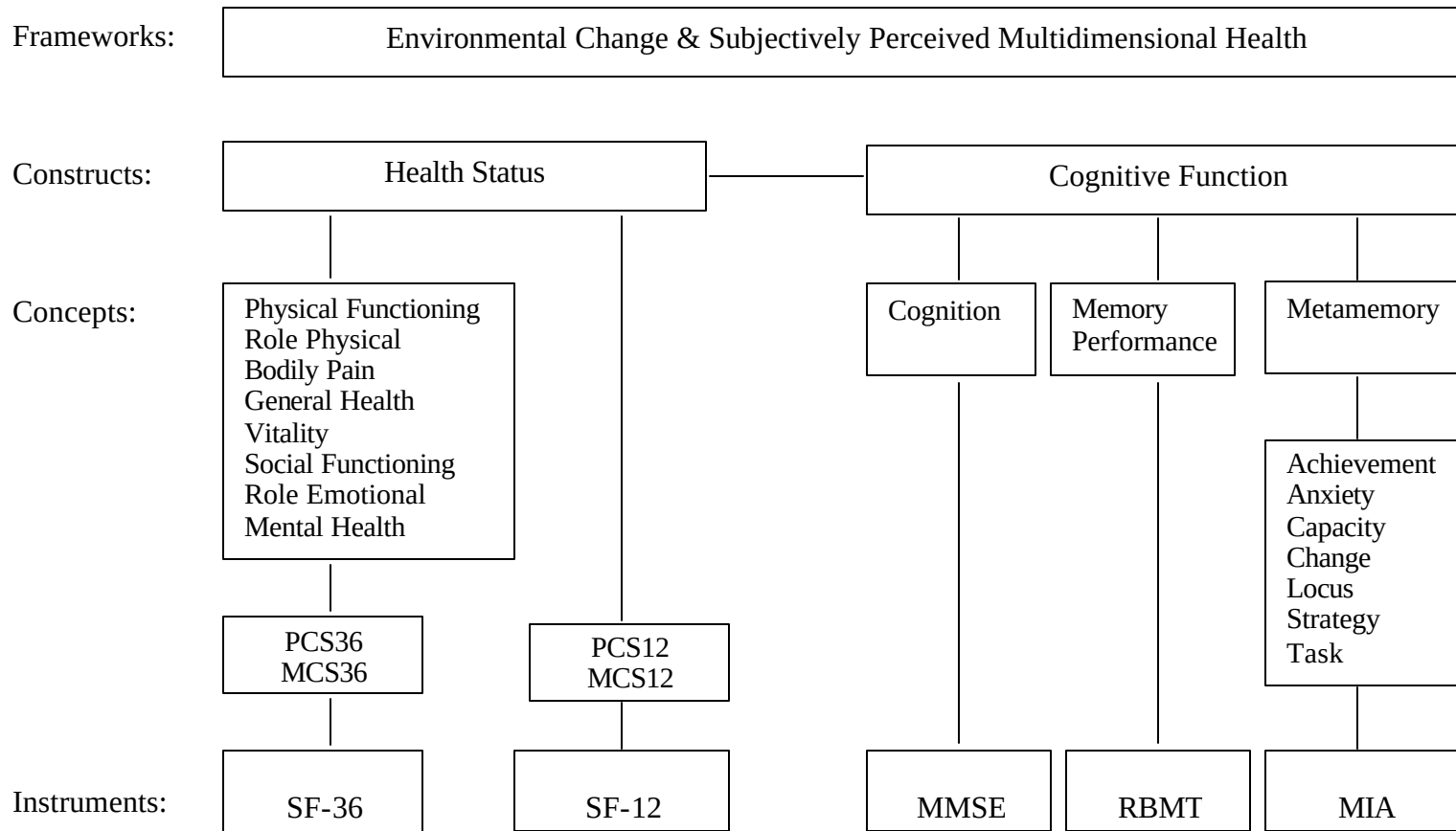
that serious confounding effects between environmental changes, which are exogenous to humans, and age-related changes, which are endogenous to humans, have a strong impact on cognitive function. Some examples of environmental changes are “health-related practices, attitudes, social roles, economic opportunities, and retirement policies” (Salthouse, 1999, p. 84), and “approaches to the prevention and cure of medical problems and sensitivity to the importance of balanced nutrition” (Salthouse, 1999, p. 85). These changes are commonly assumed to be closely related to subjective evaluation of health in general. In fact, Salthouse (1999) claims that, as a consequence of progressive changes in the current environment, quality of life among the elderly, in respect to general health and physical well-being, is better now than it was in the past. In this study, it is proposed that older adults’ subjectively evaluated health is a representation of the confounding effects between environmental changes and older adults’ physical changes or deteriorations.

Health is conceptualized as having two major dimensions: physical health and mental health. Each dimension encompasses four sub-dimensions including behavioral functioning, perceived well-being, social and role disability, and personal evaluation of health in general (Ware, Snow, Kosinski, & Gandek, 1993; World Health Organization, 1948). Each of these sub-dimensions are measured by one or more of eight health concepts: physical functioning, role limitations due to physical health problems, bodily pain, general health, vitality, social functioning, role limitations due to emotional problems, and mental health. Each dimension, either physical health or mental health, is represented by a sum score of the eight

weighted health scores. Figure 1.1 shows the relationships between frameworks, constructs, instruments, and variables.

Measurement theories related to psychological testing (American Educational Research Association, American Psychological Association, & National Council on Measurement in Education, 1999; Nunnally & Mernstein, 1994) are utilized to guide the process of comparing psychometric performances of the two health measures (SF-36 and SF-12) in predicting cognitive function. Measurement theories, in general, explain rules regarding assignment of numbers to represent study interests, while producing a minimum of errors. In the current study, the scores generated by the two health measures represent health status among the elderly. Psychometric performances of the two health measures will be assessed under the measurement theories, especially when these measures are used with older adults, aged 65 or older, and investigated with cognitive function variables.

Figure 1.1: Frameworks, Constructs, Concepts, and Instruments Employed in the Current Study.



DEFINITIONS

Older adults

The study population is older adults. For the purpose of the current study, older adults are defined as adult males or females who are aged 65 or older, who are either Caucasians or African-Americans, who are able to read and speak English as a primary language, and who are free of cognitive impairments. The term is interchangeably used with the term ‘the elderly’.

Health status

The construct of health status consists of two health dimensions: physical and mental. Health status refers to an individual’s self-evaluation of physical and mental health. Health status is measured with the Medical Outcomes Study Short Form 36-item Health Survey (SF-36) and the Medical Outcomes Study Short Form 12-item Health Survey (SF-12) in the current study. Specific health concepts are Physical Functioning, Role Physical, Bodily Pain, General Health, Vitality, Social Functioning, Role Emotional, Mental Health, Physical Component of Summary measure from SF-36 (PCS36), Mental Component of Summary measure from SF-36 (MCS36), Physical Component of Summary measure from SF-12 (PCS12), and Mental Component of Summary measure from SF-12 (MCS12). In the current study, health status is also used interchangeably with the term ‘health’.

Cognitive function

Cognitive function is a broad construct with various aspects. Some of cognitive functions are, although not exclusive to each other, attention span, concentration, intelligence, judgment, learning ability, memory, orientation, perception, problem solving, psychomotor ability, reaction time, and social intactness (Kane & Kane, 1981). However, memory is considered as the most essential aspect in normal cognitive functioning. The construct of cognitive function is further divided into three concepts in the current study: Cognition, Memory Performance, and Metamemory.

Cognition

Cognition is defined as an individual's intellectual functioning in areas such as perception, reasoning, and memory (Noll & Turkington, 1994). The operational definition of cognition is represented by objective scores measured with the Mini-Mental State Examination (Folstein, Folstein, & McHugh, 1975) which assesses five cognitive aspects: orientation, registration, attention and calculation, recall, and language. Specifically registration and recall are memory functions (Tierney, Szalai, Snow, Fisher, & Dunn, 1997).

Memory performance

Memory performance is the skill needed to maintain and manage everyday memory tasks that are necessary for older adults to continue living independently. The operational definition of memory performance is represented by objective scores measured with the Rivermead Behavioural Memory Test (Cockburn & Smith, 1989; Wilson, Cockburn, & Baddeley, 1985).

Metamemory

Metamemory refers to an individual's knowledge, belief, and perceptions of his/her own memory functioning and memory performance. In short, metamemory is the "individuals' understanding of his or her own memory functioning" (Hultsch, Hertzog, & Dixon, 1987, p.193). It is assumed that an individual would perform better in memory demanding situations if the person is aware of his/her own memory functioning and memory performance. The operational definition of metamemory is subjectively evaluated scores using the Metamemory in Adulthood questionnaire (MIA: Dixon & Hultsch, 1983a, 1983b). The MIA, which is the only subjective measure of cognitive function employed in the current study, consists of seven subscales: Achievement, Anxiety, Capacity, Change, Locus, Strategy, and Task.

ASSUMPTIONS

This study is based on the following assumptions.

1. Health is a positive, multidimensional construct.
2. Age is related to, but not a cause of, deterioration of cognitive function in the elderly.
3. Intact memory is the most essential aspect of cognitive function necessary for older adults' independent living.
4. Subjectively perceived health represents the interaction of changes that take place both inside and outside of humans.
5. Measures of health, cognition, memory performance, and metamemory are valid and reliable.

6. Three instruments, MMSE, RBMT, and MIA are ecologically valid measures of memory.
7. Scores obtained on health and metamemory were based on accurate and truthful self-reporting.
8. Scores obtained on cognition and memory performance were collected by reliable test administrators.
9. Participants in the current study do not have cognitive impairments.

LIMITATIONS

The limitations of the current study are the following.

1. The cross sectional nature of the current study limits the ability to infer causality.
2. The non-probability nature of the sample limits its generalizability.
3. The sample in the current study consists of volunteers. Therefore, it is possible that this study may have tended to over-represent healthy older adults.
4. Since the sample participated in the current study is composed of volunteers, they may have special memory concerns.
5. Since older adults with MMSE scores of less than 23 are not included in the current study, the range of cognition scores is limited. This limited range of cognition scores might attenuate correlations of this variable with other variables.

6. A potential limitation of a secondary analysis is that data collected for different research purposes may not be adequate to answer the research questions in the current study.

SUMMARY

The current study aims to investigate the association between health status and cognitive function among the elderly, aged 65 or older. In addition to studying the association, this study examines the psychometric performances of the two health measures. The significance and background of the current study were discussed in the context of the two most important issues among the aging population in the U.S.: deteriorations of health status and cognitive function. To achieve the two research aims encompassed by the current study, five research questions were posed, and theoretical frameworks have been presented. This chapter also presented definitions of terms, assumptions, and what were seen as the limitations of the current study.

CHAPTER 2: LITERATURE REVIEW

This review of the literature presents information related to the two constructs of memory and health, within the context of aging among the elderly. This chapter also presents information useful to evaluate psychometric characteristics of two health measures and three measures of cognitive function. The first section of the review discusses how memory has been conceptualized, how memory has been studied in relation to aging, why it is important to consider ecological validity in studies of memory among the elderly, and the ways in which a framework of environmental changes can be employed in the current study. The next section describes issues in defining and measuring health status especially among older adults. Next, will follow a review of studies investigating the association between health status and cognitive function. The final section presents measurement theories and methods that the current study uses to compare the psychometric performance of two health measures in relation to cognitive function among the elderly.

MEMORY

Although this study investigates the relationship between health status and cognitive function in the elderly, this section mainly focuses on memory. Memory is the most necessary aspect of cognitive function for older adults to be able to live independently and safely in the community. Memory loss is the earliest and the most frequent sign of cognitive impairment among the elderly. Two out of three instruments used to measure cognitive function in the current study assess

memory only, and the third measure of cognitive function also assesses some memory functions.

Definitions of memory in the literature are inconsistent. Memory refers primarily to the capacity to store information about the past (Perlmutter et al., 1987). To define and understand memory, it may be useful to review information processing theory. What follow after the review of information processing theory are discussions of the accuracy of older adults' memory complaints, the issues critical to investigating older adults' memory in relation to their everyday lives, and details of environmental changes framework.

Information Processing Theory

Most studies on human cognition in the 1960's were carried out using a computer as a metaphor for cognition (Anderson & Bower, 1973; Loftus & Loftus, 1976). This perspective involves specifications of information-storing structures, and processes of information handling between structures. The perspective assumes that information is first sensed, perceived, encoded, stored, and later retrieved, while the information moves back and forth between three systems in the memory. The three systems are, generally speaking, sensory, short-term, and long-term memory (Baddeley, 1982; Higbee, 1996). Studies of memory, based on this perspective, tend to examine the process of retrieving stored information under various conditions.

There are three steps of data processing between the three memory systems. First, information is sensed through sensory systems, and then perceived through verification by exchanging information between memory systems.

Memory formation begins with registering or recording perceived information in short-term memory. The information recorded in short-term memory lasts only a few minutes, after which it is generally lost. Short-term memory storage and its activity refer to limited-capacity working memory, especially as compared to the display of information on a computer. The working memory makes it possible either to directly recall information just received from short-term storage, or to transmit the information to long-term storage after rehearsing and encoding it as a form of memory trace which can later be recalled (Kausler, 1994).

The next step of memory formation is retention. It involves transference of information into the long-term memory system, which is still part of working memory. When the data is being stored in the long-term memory system, people associate the information with words, visual imagery, smell, or sounds that they have already known or experienced. These mechanisms are analogous to the backup storage of a computer system. Long-term memory can be divided into two types; episodic memory and semantic memory (Tulving, 1972). The distinction between the two types of long-term memory is based on the extent to which memory is associated with an individual's personal experience. For example, in a situation in which an individual is asked about marriage. The individual will use episodic memory dealing with personal experience to talk about his or her marriage: time, place, guests, etc. Semantic memory, also referred to as generic memory, deals with general knowledge. The individual will define what marriage is using his or her knowledge stored in semantic memory. Tulving (1985) later refers to episodic memory as remembering, and semantic memory as knowing.

Metamemory, defined as one's beliefs and knowledge about one's memory functioning, is considered to be part of generic memory (Kausler, 1994).

The final data processing step in memory is retrieval or recall. This process brings the information stored in the unconscious level into the conscious level. Even though experimental psychologists have tried hard to examine encoding and retrieval separately, it has not been successful since the process of moving information in and out of types of storage is interdependent. Retrieving information is not possible unless the information has been encoded. Neither is encoding information possible without retrieving information already stored in memory (Perlmutter et al., 1987).

As such, there are several steps of memory processing to move back and forth information freely between three memory storage systems: registering or recording, retention, and retrieval or recall. The three memory systems are sensory, short-term, and long-term memory. Various factors are believed to affect memory processes, and, most of all, health is believed to play a major role in how well a person performs memory tasks.

Age-related Memory Changes

The stereotypical belief about memory is that memory performance decreases as people age. People complain more of memory problems as they age, and studies validate these concerns (Bolla, Lindgren, Bonaccorsy, & Bleecker, 1991; Cavanaugh, Grady, & Perlmutter, 1983; Dixon & Hultsch; 1983a; Fisher, 1991; Gagnon et al., 1994; Herzog & Rodgers, 1989; Zelinski, Gilewski, & Thompson, 1980). For example, Culter and Grams (1988) asked 14,783 subjects,

aged 55 or older, about their everyday memory problems, and nearly three quarters of the participants (73.7 %) reported that they had memory problems.

However, an increase in memory complaints associated with advancing age does not necessarily represent an actual change in memory function. For a majority of aging individuals, perceived memory lapses are not as disturbing as they might appear (Perlmutter et al., 1987; Poon, 1986). The memory changes associated with advancing age usually manifest themselves as shorter attention spans, slower thinking processes, the use of fewer memory strategies, and slower learning time (Noll & Turkington, 1994). On the other hand, the memory functions that do not normally change with advancing age are “short-term memory, semantic memory, retention of well-known information, searching technique, and interference” (Noll & Turkington, 1994, p. 9). In short, memory performance with respect to fluid intelligence becomes poorer as people age, but performance on crystallized intelligence is comparable or sometimes better in older than in younger subjects (Fingerman & Perlmutter, 1994; Perlmutter & Nyquist, 1990).

Theories of cognitive aging, therefore, focus more on age-related memory changes in fluid intelligence, in other words, efficiency or effectiveness of cognitive process involving learning, reasoning, memory, and spatial abilities (Salthouse, 1999). On the other hand, crystallized intelligence, or the product of cognition, is considered less important to study. Most theorists assume that it is not necessary to focus on crystallized intelligence which stays relatively stable

throughout a person's life span. Tests such as multiple choice vocabulary and general knowledge tests serve as measures of crystallized intelligence.

While some specific abilities do decline with age, overall memory remains strong through the eighth decade (Poon, 1986). Furthermore, even age-related changes in memory abilities are actually related to how people perceive memory changes and how they perceive the process of aging. Changes are related to how strongly people feel that they are in control of their memory functioning (Dixon & Hultsch, 1983a). As an empirical example, Levy and Langer (1994) compared younger adults' memory performance (mean age = 22 years) with older adults' memory performance (mean age = 70 years) in three groups from different cultures. They found no age-associated memory impairments. Instead they found positive correlations between positive views on aging and memory performance.

Age-related memory deterioration does not necessarily always exist. Aside from aging, other factors, such as perception or belief about memory, affect memory performance changes. Surprisingly a negative appraisal of aging and memory could result in detrimental effects on actual memory performance. Although self-reported memory functioning correlates only moderately with actual memory performance (Gilewski & Zelinski, 1986), it is believed that negative perception has a negative impact on the behavior of the elderly in everyday memory demanding situations (Bandura, 1997; Lovelace, 1990; McDougall, 1999; Perlmutter et al., 1987). As a consequence of underestimating memory functioning, older adults might refrain from certain activities because they perceive themselves as having memory problems. Whether memory

problems are actually occurring is often impossible for a lay person to determine without a professional evaluation. Therefore, it is important for health professionals to accurately assess actual memory function and perceptions of memory ability in the elderly.

Once memory is accurately assessed, various strategies are available to improve, or at least maintain memory functioning (McDougall, 2000, 2001, & 2002; McDougall, Holston, & Wilke, 2001; Perlmutter et al., 1987). External memory aids can be useful in supporting memory in everyday activities. Some examples are diaries, address books, calendars, note pads, pill boxes, digital watches, and timers. Internal memory aids serve as mental strategies to enhance learning and the further recall of information. Relaxation training, for example, is useful in reducing anxiety and increasing attention.

Research studies maintain that changes in memory function are not necessarily the consequences of aging (National Research Council, 2000). The term “age-related memory” assumes that there are age-related factors which are correlated with memory deterioration. These factors, not comprehensive and not exclusive to each other, are illness, mood, perception, motivation, self-esteem, attitude, depression, anxiety, exercise, nutritional status, alcohol, drugs, and sensory functioning. Many of these extraneous factors are correlated with lifestyle and are remediable (Rowe & Kahn, 1987). Thus, it is quite possible to optimize older adults’ memory function by modifying the effects of these mediating variables (Perlmutter et al., 1987).

Importantly, health status may be responsible, at least in part, for age-related differences in cognitive function in adults. This view is very plausible when considering the fact that approximately four out of five Americans, aged 65 and older, have at least one or more chronic medical conditions (Hoffman, Rice, & Sung, 1996). However, results of studies examining the relationship between health and age-related differences in cognitive function are mixed. These inconsistent results might be attributable to issues in the assessment of memory and health status.

Ecological Validity and Everyday Memory

It is important to understand the term ecological validity since the current study collects data on memory with three ecologically valid measures: the Mini-Mental State Examination (MMSE: Folstein, Folstein, & McHugh, 1975), the Rivermead Behavioural Memory Test (RBMT: Wilson, Cockburn, & Baddeley, 1985), and the Metamemory in Adulthood Questionnaire (MIA: Dixon & Hultsch, 1983a, 1983b).

For more than a hundred years, psychologists have focused on memory in general and its underlying mechanisms (Neisser, 1982). Theories of memory were generated through standard laboratory methods. Memory was studied through specifically designed measures consisting of artificial situations and arbitrary stimuli. These artificial settings stand opposed to the naturalistic tradition. These measures purport to measure only narrowly defined parts of memory such as with the intentional verbal learning paradigm. Therefore, procedures like the Wechsler Memory Scale (Wechsler, 1945) and the Benton Visual Retention Test (Benton,

1974), common in those days, have only limited clinical value. These tests are more appropriately used to distinguish 'normal' people from those with various types of brain damage. Conventional tests do not measure factors that are believed to affect memory, and subsequently, are not useful in determining the precise level of learning ability in everyday life.

Experimental methods have been strongly criticized as barely useful in answering questions about everyday memory under natural environments. In other words, critics have pointed out that the laboratory experiments lack ecological validity and, therefore, are not useful in solving day-to-day memory problems (Avorn, 1983). As a result, new memory studies were undertaken. Cognitive and experimental psychologists moved out of their laboratories, and into natural settings, to study memory in everyday life. Considering its relatively short history, the study of everyday memory has proliferated fairly successfully (Petrinovich, 1992).

Studying everyday experiences in the real world, rather than in the laboratory, is critical in the study of everyday memory (Rubin, 1992). The most common problems relating to everyday memory are in areas such as remembering places, objects, people's faces and names, personal experiences, conversations, stories, and events (Cohen, 1989). Therefore, researchers began to ask to what extent people were aware of and dealt with everyday memory problems (Cavanaugh, 1992; Camp, 1992; Dixon, 1992). These are ecologically valid questions. Memory measures are ecologically valid when they emphasize the

exact nature of a subject's memory deficit and the implications for rehabilitation (Sunderland, 1990).

Among the various ways of investigating everyday memory, the self-reporting survey method is very popular (West, 1992). Memory questionnaires measure the subjective evaluation of memory function, and the subject's knowledge or awareness of memory processes. The subjective perception of memory is a significant component of metamemory (Cutler & Grams, 1988; Floyd & Scogin, 1997). Metamemory influences the strategies used to deal with everyday memory tasks (Hultsch, Hertzog, & Dixon, 1987), and the use of external and internal memory aids (Harris, 1980).

Subjective Measure of Memory

There are two types of memory questionnaires (Noll & Turkington, 1994). General memory questionnaires measure an individual's memory performance by asking about general knowledge or personal experiences, in other words semantic or episodic memory, respectively. The other type is metamemory questionnaires that assess an individual's memory function and belief in his/her memory performance. The clinical significance of investigating metamemory comes from the view that a person's belief about his/her own memory may affect whether that person chooses to do something or not, or how the person performs a memory task (Noll & Turkington, 1994).

Gilewski and Zelinski (1986) reviewed questionnaires assessing memory problems in the everyday lives of community-dwelling elderly. Two questionnaires, both psychometrically sound and commonly used with older

adults, are the Memory Functioning Questionnaire (MFQ: Gilewski, Zelinski, & Schaie, 1990) and the Metamemory in Adulthood Questionnaire (MIA: Dixon & Hultsch, 1983a, 1983b). The two instruments measure multiple dimensions of an individual's self-assessment of cognitive functioning. The MIA has an additional advantage of tapping into the multidimensional aspects of metamemory beyond everyday memory problems.

Metamemory is believed to have “a dynamic bidirectional relationship” (Dixon, 1992, p. 397) with memory performance, and to “contribute to cognitive efficiency in everyday life” (Dixon, 1992, p. 397). These assumptions imply that an individual would perform better in memory demanding situations if the person were aware of his/her own memory functioning and memory strategies. Metamemory is important in dealing with practical everyday memory problems among the elderly. The construct suggests the possibility of providing interventions to the elderly to ameliorate, or at least to maintain, memory function. Two meta-analyses on memory training programs concluded that the programs improved memory function both subjectively and objectively (Floyd & Scogin, 1997; Verhaeghen, Marcoen, & Goossens, 1992). The improvement was greater when training programs included strategies to improve participant's attitudes on the effects of aging on memory (Floyd & Scogin, 1997).

Objective Measures of Memory

As an alternative to subjectively assessing everyday memory, behavioral memory tests are available to objectively assess memory performance in everyday life. Since it is almost impossible to observe memory functioning in real life,

subjects are asked to perform simulated tasks that are similar to what they often encounter in everyday memory activities such as remembering a new route, recalling a person's name, or remembering an appointment. By observing a person doing those simulated tasks, researchers can make an accurate prediction of everyday memory performance. This study objectively measures older adults' memory performance in everyday situations using two tests: the Mini-Mental State Examination (MMSE: Folstein, Folstein, & McHugh, 1975) and the Rivermead Behavioural Memory Test (Cockburn & Smith, 1989; Wilson, Cockburn, & Baddeley, 1985).

The MMSE, an objective measure of basic cognitive function, assesses whether a subject is cognitively impaired. To screen out subjects with cognitive impairment, a cut-off score is used. The cut-off score evolved from previous research findings (Tombaugh & McIntyre, 1992). Subjects who have MMSE scores of less than 23 are considered to have cognitive impairment. Subjects who have MMSE scores between 18 and 22 are considered to have mild cognitive impairment, and subjects with scores between 0 and 17 are considered to have severe cognitive impairment (Cummings, 1993; Pearson, Cherrier, & Teri, 1989). The current study does not include subjects with MMSE scores lower than 23. Since memory is an important aspect of cognitive function (Tombaugh & McIntyre, 1992), numerous studies use the MMSE with non-impaired older adults for other than screening purposes. MMSE scores predict episodic memory performance (Hill & Bäckman, 1995; Wahlin et al., 1993), assess the relationship between health and cognitive function (Christensen et al., 1994), or predict the

benefits of memory training (Hill, Yesavage, Sheikh, & Friedman, 1989; Yesavage, Sheikh, Friedman, & Tanke, 1990).

The RBMT assesses everyday memory performance in the elderly. Wilson, Cockburn, and Baddeley (1985) developed the RBMT based on observing patients admitted to a rehabilitation center over a two-year period. This 12-item instrument tests memory skills necessary for functioning in real-life situations. This objective test assesses verbal, visual, and visuo-spatial memory in immediate, delayed, and prospective conditions. Initially, the RBMT was designed to assess everyday memory problems in adults aged 16 to 69, but with further testing, proved to be an acceptable test with older adults aged 70 or older as well (Cockburn & Smith, 1989).

Environmental Changes Framework

This study investigates the relationship between health and cognitive function in the elderly, aged 65 or older, based on the theoretical perspective of environmental changes (Salthouse, 1991, 1999). The environmental changes perspective posits that, as people grow older, they interact with various aspects of the ever changing environment. While people interact with various environmental changes, serious confounding effects occur between exogenous environmental changes and the persons' endogenous age-related changes. The environmental changes framework claims that, as a result of the confounding effects, cognitive changes occur in the elderly. Therefore, "what appears to be consequences of changes originating from within the organism are actually attributable to changes in the external environment" (Salthouse, 1991, p. 84).

Hertzog and Hultsch (2000) discuss the influence of societal changes on actual memory related behavior. Over the last three decades, scientific advances in knowledge about the nature of memory and cognition have increased people's awareness of aging issues. This then leads to generational differences in knowledge and, further, memory functioning. One way of measuring the level of knowledge in adulthood is using the Task scale in Metamemory in Adulthood (MIA) Questionnaire (Dixon & Hultsch, 1983a, 1983b, 1984) which captures age differences in level of knowledge (Dixon, Hertzog, & Hultsch, 1986; Dixon & Hultsch, 1983b; Hultsch, Hertzog, & Dixon, 1987). However, not all effects of advancing knowledge are positive. Increased awareness about the nature of Alzheimer's disease, for example, and its high prevalence may cause middle-aged and older adults to fear the disease (Cutler & Hodgson, 1996; Hertzog & Hultsch, 2000), and, therefore, to have detrimental effects on memory performance. Unrealistic fear might cause people to avoid challenges, which, in turn, could reduce mental capacities even further (Bandura, 1989; Perlmutter et al., 1987).

Environmental changes vary. In social and cultural dimensions, broadly defined changes are "health-related practices, attitudes, social roles, economic opportunities, and retirement policies" (Salthouse, 1991, p. 84-85). Examples of specifically defined changes are the number of single-parent families, the average hours per week spent watching television, and educational practices or standards. Changes also occur in biological and physical dimensions of the environment, such as, "approaches to the prevention and cure of medical problems and sensitivity to the importance of balanced nutrition" (Salthouse, 1991, p. 85). Any

of these changes is closely related to an individual's health. As a consequence of changes in the environment, people today have better health in general than in the past.

The influence of environmental changes on cognition was found to be significant in studies when the time-lag method was employed (Schaie, 1996; Tuddenham, 1948). As a result of using the time-lag method, historical improvements in cognitive performance over time were found. This longitudinal method involves two or more samples of people in the same age range, who live in different chronological time periods. Cognitive performance of one sample at a certain age range is compared to the performance of other samples at the same age range but at different historical times. The time-lag method shows that test scores from recent generations are higher than past generations.

The environmental changes view does not yet clearly explain age-related differences in cognitive function (Salthouse, 1999), and it is uncertain which factors in the environment are responsible for specific cognitive changes. Still it is important to acknowledge the perspective's capacity of integrating various factors which seem to influence age-related cognitive differences (Salthouse, 1999). Since the environmental change perspective is not yet fully developed, it does not provide specific hypotheses regarding particular aspects in the environment that are presumed to be responsible for changes in cognitive function. It is, therefore, a framework, rather than a theory or a model.

This study proposes that subjectively measured health status is an appropriate construct for representing the interactive effects of changes both

inside and outside of humans. Health status under this theoretical framework is assumed to represent older adults' perceptions of various changes in the environment and interactions of those changes with individual changes. Therefore, subjectively measured health status will be used to account for some of the differences of cognitive function in the elderly.

HEALTH

Assessing older adults' health is particularly problematic since conceptualizing health is more complicated with older people, possibly due to common attitudes toward aging. People often consider chronological aging as akin to illness and/or degeneration. In this stereotypically negative view, changes in health are considered to be the result of aging, not health-related conditions (Patrick & Erickson, 1993). Another complicating factor may be that the presence or absence of disease is often not an appropriate description of health in the elderly. Even though a considerable number of older people have chronic conditions (Hoffman, Rice, & Sung, 1996), they tend to consider themselves healthy. The disease-oriented view of health, therefore, may not be appropriate to develop meaningful health indicators for use with older adults.

Issues in Defining Health

Health has been defined, in practice, either in terms of the presence or absence of disease, or in terms of function (Shanas & Maddox, 1976). The majority of health measures define health in terms of function (McDowell & Newell, 1996). This function-related definition of health was initially proposed by Parsons (1958). In his social view, health is a state of optimum capacity for

performance of the roles and tasks for which a person has been socialized. An individual is considered healthy if that person is physically and mentally able to perform personal tasks and social roles. This model defines health in relation to the level of an individual's fitness in terms of social expectation, rather than simple diseases. The model shifts the focus of health from an absolute state of disease or illness, to the interactive process between individuals and their social contexts (Maddox, 1987).

Further levels of functioning are impairment, disability, and handicap (Brown, 1993; Shanas & Maddox, 1976; World Health Organization, 1980). An impairment refers to a reduction in physical or mental capacities that does not interfere with the normal activities of an individual. Impairments generally occur at the organ level, and may not be visible, or result in unfavorable consequences in terms of function. For example, impaired vision can easily be corrected by wearing glasses. Disability refers to a restriction of the ability to perform normal activities. Disability results in partial or total limitation of an individual's daily activities. If a disability is not severe, the person with the disability may be able to carry out social roles. An elderly person with partial blindness may be disabled, but still be able to carry out daily activities, and thus maintain a functionally adequate life style. A handicap is seen as a social disadvantage, such loss of hearing. Medical treatments are usually focused on impairments, but patients and society are more interested in disability than impairments (McDowell & Newell, 1996). In any case, assessment of health function still falls under the disease-

oriented model of health. Nevertheless, measurement of health is much more than assessing negative aspects such as disability, impairment, or handicap.

Researchers involved in developing and testing health measures agree that health is a multifaceted concept encompassing physical, mental, and social dimensions (Kane & Kane, 1981). A multidimensional view of health can yield a more complete and accurate picture of a person's whole experience (George, 1994). Measurement of health also should encompass the full spectrum of health status ranging from a negative state of dysfunction to a positive state of well-being (Ware, 1987). As such, when the positive state of well-being is incorporated into the conceptualization of health, the idea of quality of life (QOL) can be used to help define health, or may even be equated with health. However, by traditional definitions, QOL is much broader than health itself (Ware, 1974).

The term, QOL, first appeared in the literature in 1920 (Pigou, 1920). Development of measures to assess QOL began in the 1970s. Studies and discussions of the term increased throughout the 1980s and 1990s (Wood-Dauphinee, 1999). However, QOL was difficult to define and measure. Researchers began to look at the impact of disease and its treatment on people's lives, and called it health-related quality of life (HRQOL). The term, HRQOL, is more specific and appropriate for purposes of clinical research, and refers to an individual's appraisal of his/her level of function and satisfaction with the current level of function (Cella & Tulsky, 1990). Therefore, HRQOL is considered synonymous with subjective health status assessment (Berzon, 1998).

Health-related quality of life (HRQOL) includes the definition of health from the World Health Organization, which states that health is not merely the absence of disease or infirmity, but a state of complete physical, mental, and social well-being (World Health Organization, 1948). Based on this broad definition, HRQOL instruments measure not only the presence of disease and/or the severity of symptoms, but also how people experience illness and its treatments. HRQOL incorporates five concepts: duration of life, impairment, functional status, health perceptions, and social opportunities. These concepts are health-related to the extent that they are influenced by disease, injury, treatment, or policy (Patrick & Erickson, 1993).

There are two types of HRQOL measures: specific and generic (Berzon, 1998). If a specific instrument is intended for use within a similar set of conditions such as cancer, it is referred to as condition-specific. If a questionnaire is restricted to a particular cancer, it is referred to as a disease-specific instrument. Depending on the restriction, a questionnaire can be treatment-specific, trial-specific, or situation-specific. Specific measures are sensitive to changes. However, specific measures may not allow comparisons of cross-conditions.

Generic instruments make it possible to compare across conditions and interventions, but may not be appropriate for focusing on specific diseases or interventions. Examples of generic measures are Medical Outcomes Study (MOS) Short Form (SF: Stewart, Hays, & Ware, 1988; Ware & Sherbourne, 1992) and Sickness Impact Profile (SIP, Bergner, Bobbitt, Pollard, Martin, & Gilson, 1976; Pollard, Bobbitt, Bergner, Martin, & Gilson, 1976). A generic health profile

questionnaire assesses a subject's ability to perform everyday activities across a broad range of domains such as physical, social, role activities and emotional well-being. In summary, the definition of health status should encompass the multidimensional health experience of a person, and acknowledge the full health spectrum, from worst to best. A generic measure of HRQOL, such as SF-36, may come closer to accomplishing this goal than other measures.

Conceptual Framework of SF-36

Ware and colleagues (Ware, 1987; Ware, Brook, Davies, & Lohr, 1981; Ware, Snow, Kosinski, & Gandek, 1993; Ware et al., 1980) derived their definition of health from the World Health Organization (WHO)'s definition of health and common meanings of health in a dictionary. The WHO defined health as a state of complete physical, mental, and social well-being (World Health Organization, 1948). Connotations of health in a dictionary (Oxford English Dictionary, 1961) included completeness, proper function, and well-being. Health implied soundness of mental functioning as well as soundness of body. According to a dictionary, the health of an individual is seen as comprised of two common dimensions: physical and mental.

The social aspect of health is unlike the physical or mental aspects of health. The social aspect is external to an individual, while the physical and mental aspects are "similar that they end at the skin" (Ware, Brook, Davies, & Lohr, 1981, p. 5). Examples of social variables external to an individual are quantity and quality of social contacts, and social resources. Therefore, Ware et al. (1980) focused more on the physical and mental dimensions of health while

acknowledging the effects of the social aspect of health. A health status model which defines the social aspect as external but acknowledges its effect on health may explain empirical data better than one focusing on social variables as an integral part of an individual's health.

With these two dimensions of health in mind, Ware et al. (Ware, Snow, Kosinski, & Gandek, 1993) developed the SF-36 with eight subscales. The two dimensions of health, physical and mental, are broken down into four sub-dimensions: behavioral functioning, perceived well-being, social and role disability, and personal evaluations of health in general. Each of these four sub-dimensions of health are measured with one or more of the subscales in SF-36. Table 2.1 shows the relationships between two dimensions of physical and mental health, the four sub-dimensions of health, and the eight health concepts measured with the eight subscales in SF-36.

The four sub-dimensions of health are not clearly defined, but some examples and brief explanations are offered. Measures of behavioral functioning assess the capacity to perform a variety of activities that are normal for an individual in good health. The indicators to assess behavioral functioning such as walking, bathing, and dressing are observable and tangible. Perceived well-being, as a psychological state, cannot be inferred from observable behaviors, and involves more than functioning or disability. Three scales measure perceived well-being: Mental Health, Bodily Pain, and Vitality. Social and role disability assesses the level of limitations in physical, social, and role activities due to poor health and/or bodily pain. Personal evaluation of health reflects the impact of

specific symptoms and other health aspects not included in the other three sub-dimensions of health. Subjects are asked to evaluate their current health status and expectations for health in the near future, such as susceptibility to illness (Ware, Snow, Kosinski, & Gandek, 1993). The SF-36 does not provide a global index of health, but, instead, provides eight health profile scores representing the eight health concepts. By weighting and summing the eight health profile scores, two summary scores which represent the two dimensions of health are computed. Table 2.2 summarizes the interpretation of scores in the eight subscales in SF-36.

In addition to the eight subscales listed in Table 2.1 and Table 2.2, SF-36 includes one more scale which consists of only one item and addresses a person's health transitions. Subjects are asked to compare their current health status to the previous week in the acute version, or over the last month in the standard version. The responses to this one-item scale are treated as ordinal level data, and analyzed by the percentage of respondents who selected each response. This one-item scale is not one of the eight health variables, and does not contribute to the computation of summary measures. Therefore this one-item scale will not be hereafter discussed.

Table 2.1: Health Phenomena Measured with SF-36.

SF-36 Subscales	Dimensions of Health							
	Physical Health				Mental Health			
	Function	Well-being	Disability	Personal Evaluation	Function	Well-being	Disability	Personal Evaluation
Physical Functioning	•							
Role Physical			•					
Bodily Pain		•	•					
General Health				•				•
Vitality		•				•		
Social Functioning			•				•	
Role Emotional							•	
Mental Health					•	•		

Note. Adapted from “SF-36 Health Survey: Manual and interpretation guide” by J. E. Ware, K. K. Snow, M. Kosinski, and B. Gandek, 1993, p. 3:3.

Table 2.2: Interpretation of SF-36 Subscale Scores.

Subscale	Low Scores	High Scores
Physical Functioning	Limited a lot in performing all physical activities including bathing or dressing due to health.	Performs all types of physical activities including the most vigorous without limitations due to health
Role Physical	Problems with work or other daily activities as a result of physical health	No problems with work or other daily activities as a result of physical health
Bodily Pain	Very severe and extremely limiting pain	No pain or limitations due to pain
General Health	Evaluates personal health as poor and believes it is likely to get worse	Evaluates personal health as excellent
Vitality	Feels tired and worn out all of the time	Feels full of pep and energy all of the time
Social Functioning	Extreme and frequent interference with normal social activities due to physical or emotional problems	Performs normal social activities without interference due to physical or emotional problems
Role Emotional	Problems with work or other daily activities as a result of emotional problems	No problems with work or other daily activities as a result of emotional problems
Mental Health	Feelings of nervousness and depression all of the time	Feels peaceful, happy, and calm all of the time

Note. Adapted from “SF-36 Health Survey: Manual and interpretation guide” by J. E. Ware, K. K. Snow, M. Kosinski, and B. Gandek, 1993, p. 3:5.

SF-36 and Older Adults

The appropriateness of using the SF-36 to assess older adults' health status is controversial. Some researchers warned that caution is required when SF-36 is administered to older adults (Lloyd, 1999; Parker, Peet, Jagger, Farhan, & Castleden, 1998). In general, the quality of health data, gathered from elderly respondents, 65-years old or older, has been questioned when compared to the data from younger respondents (Colsher & Wallace, 1989; Demaio, 1980; Magaziner, Simonsick, Kashner, & Hebel, 1988; Schuman & Presser, 1981). These researchers argued that age-related cognitive changes in the elderly might have influenced older adults' perceptions of health status.

Other researchers, however, argued that age-related cognitive changes do not affect the way older adults respond to questionnaire surveys. Colsher and Wallace (1989), in a population-based health survey of elderly persons, evaluated data quality by examining the number of unanswered items and the number of inconsistently responded items. However, they realized that they could not make decisions on data quality with those indicators alone, since older people were highly responsive, and fairly consistent in responding to measures. In addition, McHorney, Teno, Lu, Sherbourne, and Ware (1990) examined the quality of health survey data from a group of older people who were aged 60 or older, and who were cognitively impaired as determined by the Mini-Mental State Examination (Folstein, Folstein, & McHugh, 1975). The participants took twice as long to complete the health survey than cognitively intact subjects, and had more missing data. However, the data were psychometrically reliable and valid

when compared to the data from the group with no cognitive impairments. It is important to note that a person can report pain or feelings of sadness even when that person does not know the date, time, or name of the current president.

Some researchers, however, strongly support the appropriateness of using SF-36 with older people (Beusterien, Steinwald, & Ware, 1996; Gandek et al., 1998; Lyons, Perry, & Littlepage, 1994; O'Mahony, Rodgers, Thomson, Dobson, & James, 1998; Stadnyk, 1997; Wolinsky, Wan, & Tierney, 1998). It seems that the body of evidence supporting the inappropriateness of using SF-36 with older adults is fairly limited and sometimes anecdotal (Jenkinson, 1999). Overall consensus on using SF-36 with older adults is that the measure is not problematic as long as a rigorous study design is planned and administered. However, the review of literature here has focused on the eight subscales in SF-36. No study has compared older adults' health status measured with summary measures in SF-36 and SF-12, in relation to older adults' cognitive function.

HEALTH AND COGNITIVE FUNCTION

The current study investigates the relationship between subjectively perceived health status and cognitive function in the elderly. Before reviewing the literature on cognitive function regarding older adults' perceptions of health, the literature review will be conducted to determine how cognitive function has been studied in relation to objectively assessed health.

Objective Health and Cognitive Function

Objectivity of a measure refers to whether the measure is observable. A measure of objective health is obtained when a health professional assesses an

individual's health using physical examination, laboratory tests, and/or objective instruments such as the Functional Independence Measure (Stineman et al., 1994). An objective health measure is also obtained by surveying subjects regarding health indicators, or by reviewing medical records. Examples of indicators are the number of medical conditions or diseases, drugs prescribed and taken, contacts with physicians, days in bed, and days of hospitalization in the last 6 months.

Some researchers employed extensive medical screening tests to rule out subjects with conditions potentially debilitating to cognitive function (Albert, Duffy, & Naeser, 1987; Birren & Spieth, 1962; Botwinick & Birren, 1963; Hill, Grut et al., 1995; Spieth, 1964). These researchers compared the cognitive function of subjects in supposedly optimal health to the cognitive function of subjects with average health. These researchers hypothesized that, if health mediates the relationship between age and cognition, age-related decline of cognitive function will be absent or minimized when the function is measured with adults in optimal health. However, health was not a significant mediator between age and cognition in the optimally healthy adults. Therefore, the hypothesis was not supported. Limitations in those studies may be attributable to the failure of support for the hypothesis; the small sample (Botwinick & Birren, 1963), the high level of education and socioeconomic status in the optimally healthy subjects (Birren & Spieth, 1962), or adults aged only 60 or below (Birren & Spieth, 1962, Spieth, 1964). Nevertheless, even within optimally healthy subjects, age-related changes in cognitive function were evident. Thus, the

hypothesized mediating effect of health was not supported when health was conceptualized and measured under the disease-oriented view.

Others investigated objective indicators of health as mediators of age-related cognitive changes. The indicators were collected from records and provided by subjects. The indicators collected from subjects are considered objective measures of health because an external observer can easily verify them (Lawton & Lawrence, 1994). Results were inconclusive when objective indicators represented health. While some researchers (Ferrucci et al., 1993) found that health indicators, collected from medical records and subjects, significantly affected cognitive performance in an older population, others (Cockburn & Smith, 1991; Jellicic, Jonker, & Deeg, 1999) failed to find a significant contribution of health on cognitive function. Objective health indicators may not be sensitive enough to describe the broad picture of health in any population (Patrick & Erickson, 1993). In summary, it is inconclusive whether health mediates age-related cognitive changes when health is conceptualized and assessed objectively within a disease-oriented framework.

Subjective Health

Contrary to objective health, subjective health is assessed by asking subjects to evaluate and rate their own level of health. This method is often preferred to the objective method because it is simpler and cheaper. Researchers agree that health status is a subjective concept with each individual being the best source of knowledge regarding his/her own health (Hays, Sherbourne, & Mazel, 1995; Ware, 1993). Subjectively assessed health has practical significance as

well. It is individual older adults, not health professionals, who evaluate their own health and decide to keep or stop participating in social activities. Studies showed that refraining from social activities was associated with deteriorating cognitive function (Arbuckle, Gold, & Andres, 1986; Avorn, 1983).

The subjective method, however, often raises questions of validity. In an effort to support the validity of subjectively measured health, researchers cite significant correlations between self-rated health and three types of evidence: physician's rating of health (Ferraro, 1980; LaRue, Bank, Jarvik, & Hetland, 1979; Maddox & Douglass, 1973), number of medical problems or prescribed medications (Fillenbaum, 1979; Kaplan & Camacho, 1983; Liang, 1986; Mossey & Shapiro, 1982; Pilpel, Carmel, & Galinsky, 1988; Rodin & McAvay, 1992; Salthouse, Kausler, & Sauls, 1990), and survival or longevity (Botwinick, West, & Storandt, 1978; Idler, Kasl, & Lemke, 1990; Kaplan, Barell, & Lusky, 1988; Kaplan & Camacho, 1983; Mossey & Shapiro, 1982; Wolinsky & Johnson, 1992). These aspects certainly provide a degree of credibility to self-rated health.

Another criticism is that subjectively assessed health is often not strongly associated with an individual's age, especially when the subjective health is assessed with older adults. Older people often report their health to be better than younger people's health (Cockerham, Sharp, & Wilcox, 1983; Ferraro, 1980; Maddox & Douglas, 1973; Murray, Dunn, & Tarnopolsky, 1982; Rakowski & Cryan, 1990; Stoller, 1984). This optimistic evaluation of health is contrary to the general expectation that illness and weakness increase with age.

Two explanations may be pertinent to the optimistic evaluation of health. People place more emphasis on health as a state of mind as they age, even when they have illnesses (Van Mannen, 1988). Elderly people place more value on being independent. Therefore, they do not consider themselves to have lower level of health as long as they can continue the basic activities of daily living (Schank & Lough, 1990).

However, two meta-analyses of studies on subjective health and age suggested that older adults do have the ability to reliably evaluate their own health. The studies concluded that subjective health evaluated by older adults does decline as people age. In one meta-analysis of cross-sectional studies on aging and health appraisal, younger people, aged 60 or below, evaluated their health as being better than older people (Roberts, 1999). Another meta-analysis of longitudinal studies reported a similar finding; Age-associated decline of subjective health was greater in old-old samples than in young-old samples (Pinquart, 2001). Pinquart (2001) also found that the association between subjective health with functional or physical health was stronger when subjective health was measured with a multi-item questionnaire rather than a single-item scale.

Subjective Health and Cognitive Function

Self-rated health in general, measured with a one-item scale, has been extensively used in population-based studies for several reasons. Subjectively rated health is considered as a less expensive and more convenient way of looking at general health status. Thus, the National Health Interview Survey has been

using a one-item scale to assess perceived health status since 1973. A one-item scale asks subjects to rate their health in general as either excellent, very good, good, fair, or poor (Brody, Brock, & Williams, 1987).

The mediating effect of health assessed with a one-item scale on age-related cognitive changes is inconclusive. While some researchers found a significant link between self-rated health and cognitive function in older adults (Cutler & Grams, 1988; Earles, Connor, Smith, & Park, 1997; Field, Schaie, & Leino, 1988; Hultsch, Hammer, & Small, 1993; Perlmutter & Nyquist, 1990; Ponds, van Boxtel, & Jolles, 2000), others did not (Salthouse, Kausler, & Saults, 1990; Salthouse & Michell, 1990; Salthouse, Mitchell, Skovroneck, & Babcock, 1989). For example, Salthouse, Kausler, and Saults (1990) found no significant change in the regression equation predicting memory performance with age, after adjusting for self-rated health status. Subjects rated their health status on a one-item scale ranging from 1 for excellent to 5 for poor. Interestingly, the study found significant associations between age and the number of prescription medications currently taken per week, and between age and the incidence of treatments for heart or blood pressure problems in the last five years. Health status rated on the one-item scale did not mediate the relationship between age and cognitive performance.

The insignificant health effects found in previously reviewed studies, however, do not suggest that there is no health effect on the age-cognition relationship, but may be influenced by two possible sources of bias. The study participants may be positively biased in their perception of health, and show age-

related changes of cognition regardless of their health status (Salthouse, 1991). The other source of bias may be found in the health measure. Subjective health rated on a one-item scale, ranging from 1 (excellent) to 5 (poor), is “extremely crude” (Salthouse, Kausler, & Saults, 1990, p. 159) in trying to capture the many health factors that could affect cognitive functioning. It is important to use more sensitive health measures to be able to more fully reveal the influence of health factors on cognitive function (Salthouse, 1991). Multi-item measures of subjective health have higher correlations with objective health indices than single-item measures (Pinquart, 2001). It is highly recommended that a multi-item measure of subjective health be used when studying the relationship between age and cognitive function in older adults.

Health status seems to be sensitive to the variance in age-related cognitive changes in the elderly when the health status is assessed multidimensionally using multi-item tools. Ware et al. (Ware, Brook, Davies, & Lohr, 1981) argued that global or composite indicators of health are too crude, difficult to interpret, and misleading. They described health status as being similar to a bowl of fruit, therefore, it is not reasonable to try to average apples and oranges. Permuter and Nyquist (1990), for example, assessed physical and mental health separately, and investigated the effects of subjectively measured health status on intelligence performance across adulthood from 20 to 90 years of age. The most interesting finding was that both physical and mental health together accounted for a significant portion of observed variance in intelligence performance, particularly in older adults, even when age differences in health were statistically controlled.

These findings suggest the need to address both aspects of health, physical and mental, in studies on age-related cognitive changes.

Ponds, van Boxtel, and Jolles (2000) examined cognitive functioning in the domains of memory, attention, mental speed, planning, and decision making in relation to subjectively perceived health. Health was measured with a 21-item scale probing both somatic and psychosomatic health complaints. Almost 2,000 subjects between 24 to 86 years of age participated in the study. Results showed that cognitive functioning in all measured domains began to decline at the age of 50. Ponds et al. (2000) concluded that age was the most significant predictor for declining cognitive functioning, followed by health and depression.

In summary, strong associations exist between health status and cognitive functioning in the elderly, especially when health status measures are sensitive and encompass both physical and mental aspects of health. These findings are important to nurses who provide interventions to improve older adults' health promoting behaviors. By doing so, changes might come not only in perceived health status, but also in performances on cognitive functioning, and in the long run in the quality of life perceived by these older adults.

MEASUREMENT THEORIES

The current study evaluates the suitability of SF-12 as an alternative to SF-36 in assessing older adults' health status, and predicting cognitive function in the elderly. Both SF-36 and SF-12 are general health measures with well established reliability and validity (Ware, Kosinski, & Keller, 1995; Ware, Snow, Kosinski, & Gandek, 1993). Health status measured by these instruments has mainly been

used for evaluation purposes, such as examining the outcome of an intervention. The current study contends that health status measured with SF-36 and SF-12 might be associated with cognitive function. The current study examines how the two health measures would differ in explaining aspects of cognitive function. Some measurement theories are used as a basis for investigating the validation process of the two health measures. This section discusses those measurement theories while answering the following questions: (1) what is measurement, (2) what errors are involved in a measurement process and why, and (3) what methods are called for to ensure that measurement errors are controlled as much as possible.

Measurement and Error

Measurement, in general, is a process of studying a concept quantitatively, and “consists of rules for assigning numbers to objects in such a way as to represent quantities of attributes” (Nunnally, 1978, p. 3). A researcher assigns a number to an attribute or characteristic, of an object of interest, not to the object itself. By doing so, it becomes easier for the researcher to communicate with others about the measured attribute objectively, precisely, and economically (Polit & Hungler, 1995). Researchers also can employ powerful statistical analysis with the quantifications of abstracts of interest and, then as the most important feature of scientific work, make scientific generalizations (Nunnally, 1978). The method of assigning numbers to attributes of interest can be nominal, ordinal, interval, or ratio level (Steven, 1946). This measurement scale determines which type of mathematical analysis is needed, and how to interpret the results.

The goal of measurement is to accurately represent an abstract numerically. Error, however, always occurs in a measurement process, and, thus, confounds the true phenomena of interest. There are two types of measurement error: random and systematic error (Waltz, Strickland, & Lenz, 1991). Random or variable error is influenced by chance factors. Random error occurs in an unsystematic manner in all measuring processes; Whereas, systematic error influences the measuring procedures systematically. Reliability and validity are the two basic ways to evaluate measuring processes. Reliability is closely affected by random error while validity is more threatened by systematic error. Validity and reliability are the two psychometric properties for which an instrument should be evaluated to determine whether the instrument meets minimum recognized standards for a measurement. Data taken from such a valid and reliable instrument is considered credible (Berzon, 1998).

Reliability and Random Error

Reliability refers to “the consistency of such measurements when the testing procedure is repeated on a population of individuals or groups” (American Educational Research Association, American Psychological Association, & National Council on Measurement in Education, 1999, p. 25). A reliable measure yields consistent results on repeated measurements of the same attribute. Random error directly influences the reliability of a measuring instrument. There is an inverse relationship between random error and reliability. A highly reliable instrument introduces the least amount of random error. Even though there is no way to determine the exact amount of random error and a certain amount of error

always exists, the most effective means of minimizing the error is by conducting many independent measurements (Waltz, Strickland, & Lenz, 1991).

The discussion of reliability is based on the classic measurement theory which assesses random measurement error (Waltz, Strickland, & Lenz, 1991). The classic measurement theory assumes that random error must be considered in all measurement because every measured score consists of two components: true score and error score. The underlying principle can be written in an equation symbolically as follows: Obtained score (O) = True score (T) + Error (E). The equation shows that the obtained or observed score consists of true score and error of measurement. The true score is the precise amount of the attribute possessed by the object. The error score, which is referred to as the error of measurement in the classic measurement theory, reflects the influence of random error on the obtained score. True score and error are hypothetical entities. Therefore, the amount of true score or error of measurement is unknown.

The measurement theory assumes that the true score in an observed score is fixed. If, under this assumption, an attribute of interest is measured an infinite number of times, the observed scores will vary. Variability in observed scores results from the influence of random error that occurs by chance when each measurement is taken. Some of the obtained scores will be larger than the true score, while others will be smaller. Hence, the classic measurement theory assumes that random error is normally distributed. Therefore, “the effects of random error can be expected to cancel out if many independent measures of the

same attribute of an object or event are made and averaged” (Waltz, Strickland, & Lenz, 1991, p. 91).

There are several ways to assess reliability. The popular ways to assess reliability are stability, internal consistency, and equivalence (Polit & Hungler, 1995). The current study assesses reliability of an instrument with the internal consistency approach using the Cronbach’s alpha or coefficient alpha. The Cronbach’s alpha is the most widely used method for assessing internal consistency, which examines whether all items in a scale measure the intended attribute. Since the alpha is calculated using correlations between items in a scale, the number of items in the measure is critical: The more items are in a measure, the greater the chance for a large reliability coefficient (Nunnally, 1978).

Validity and Systematic Error

The definition of validity is “the degree to which evidence and theory support the interpretations of test scores entailed by proposed uses of tests” (American Educational Research Association, American Psychological Association, & National Council on Measurement in Education, 1999, p. 9). Validity is inversely related to systematic error. As is the case with reliability, it is not possible to obtain a perfectly valid empirical indicator that represents only the intended concept. A number of factors contribute to the systematic error in a measurement process. However, the sources of systematic error do not fluctuate from one measurement situation to the next as is the case with random error (Waltz, Strickland, & Lenz, 1991).

Reliability and validity do not vary distinctively from each other. They are related to each other. First, a highly reliable measure can have low validity. Consistency of results does not necessarily mean that a tool effectively measures the concept that it is supposed to measure. Second, a measuring procedure with low reliability cannot have an acceptable degree of validity. Therefore, “reliability is a necessary but not sufficient condition for validity” (Waltz, Strickland, & Lenz, 1991, p. 89).

There are various sources of evidence for validity that are used to evaluate the appropriateness of an interpretation of a test score for a particular intended purpose. Some examples of methods used to evaluate the appropriateness of a test score are test contents, response processes, internal structures, relations to other variables, and/or consequences of testing. The current study will add to our knowledge of the extent to whether health status measured with SF-36 is related to cognitive function in the elderly aged 65 or older, and whether the same relationship is found when the health status is measured with SF-12. By helping us gain these knowledge, construct validity evidence, the broadest sense of validity in the two health instruments, will be sought.

Practicality in Selecting a Health Measure

Reliability and validity are the major issues to be taken into consideration when selecting a health measure. Another important criteria is practicality (Ware, Brook, Davies, & Lohr, 1981), which is different from a psychometric point of view. Practicality can be addressed in at least three ways. The first is allocating resources. The method selected to administer a health measure should employ the

best use of available time and money, choosing from face-to-face interview, phone interview, or self-administration. Some researchers (Weinberger et al., 1994) suggest to use the face-to-face interview method, instead of self-administration of SF-36, to increase data quality, since the data from the two methods are not interchangeable. However, when considering cost and convenience, phone and mail surveys are preferred. The face-to-face administration of SF-36 takes significantly more time than the telephone interview (14.0 vs. 10.2 minutes, $p < 0.001$).

The second aspect of practicality is respondent burden. Indicators of respondent burden are refusal to respond, higher rates of missing responses, and longer administration times. Finally, for researchers and consumers of research, good health measures should not be complicated. At every step along the way from administering to data handling, analyzing, and interpreting, the simplest approach should be adopted. Interpreting two summary measure scores of SF-36 or SF-12 in relation to cognitive function in the elderly would be much simpler than interpreting the eight health profile scores of SF-36. Both SF-36 and SF-12 yield two summary measures each. If the two summary measures of SF-12 work as well as the two summary measures of SF-36, without significant loss of psychometric properties, the SF-12 would be the practical choice for studies with older adults or for population-based large studies.

SUMMARY

The current study investigates the association between subjectively perceived health status and cognitive function in community-living older adults,

aged 65 or older, while comparing the two health measures regarding cognitive function. Therefore, the literature review presented here was focused on issues in the measurement of older adults' health status and cognitive function. The review was also conducted with an eye towards examining the association between the two constructs. The last section of this chapter presented a overview of measurement theories.

CHAPTER 3: METHODS

This chapter presents the methods used in the current study. Details of the methods include descriptions of population and sample, data collection procedures, instrumentation, and the statistical analysis plan.

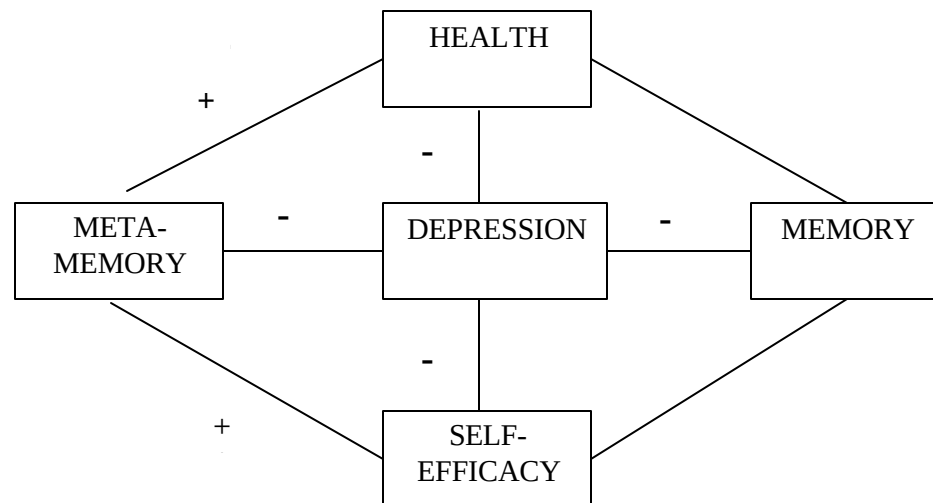
POPULATION AND SAMPLE

The target population in the current study is older adults who are aged 65 or older, who are Caucasians or African-Americans, who can speak and read English as a primary language, and who do not have cognitive impairments. This secondary analysis study uses data extracted from an existing data set which compiles data from three primary studies of memory performance in the community elderly (McDougall, 2001, 2002; McDougall, Holston, & Wilke, 2001). These primary studies were conducted by Graham J. McDougall, Ph.D., R.N., and F.A.A.N, in the period of 1996 to 1998. The approvals of the human subjects for the three primary studies were obtained from the IRB at the Case Western Reserve University because those studies were conducted while Dr. McDougall was at the Frances Payne Bolton School of Nursing at Case Western Reserve University.

The study by McDougall, Holston, and Wilke (2001) aimed to evaluate the effectiveness of a predictive model of everyday memory performance (see Figure 3.1). The other two (McDougall, 2001, 2002) were intervention studies aimed to ameliorate and/or improve memory performance and memory self-efficacy in older adults based on the predictive model. These two intervention

studies (McDougall, 2001, 2002) used quasi-experimental designs with pre- and post-intervention measurements. The current study analyzed data collected before administering any intervention. The IRB approval of the current secondary analysis study was obtained from the University of Texas at Austin (see Appendix A).

Figure 3.1: Predictive Model of Everyday Memory Performance.



DATA COLLECTION

Study participants in the three primary studies were recruited through various methods such as flyers, face-to-face contacts, or presentations. When an individual showed an interest in participating in any of the memory studies, a trained interviewer made sure, either by phone interview or by face-to-face contact, that each individual met the criteria for study eligibility regarding

language, age, race, and cognitive function. The Mini-Mental State Examination (MMSE) was used to screen subjects for cognitive impairments. Once all eligibility requirements were met, each subject met face-to-face with a trained interviewer, and completed a questionnaire packet including Medical Outcomes Study Short Form 36-item Health Survey (Ware, Snow, Kosinski, & Gandek, 1993), Center of Epidemiological Studies Depression scale (Himmelfarb, & Murrell, 1983; Radloff, & Teri, 1986), Memory Self-Efficacy Questionnaire (Berry, West, & Dennehey, 1989), Metamemory in Adulthood Questionnaire (Dixon & Hultsch, 1983a, 1983b), Instrumental Activities of Daily Living (Lawton, 1988; Lawton, Moss, Fulcomer, & Kleban, 1982), and Rivermead Behavioural Memory Test (Cockburn & Smith, 1989; Wilson, Cockburn, & Baddeley, 1985). The primary investigator, Dr. McDougall, is responsible for the database.

What follows next are details of each primary study, including purpose, design, funding source, recruiting process and place, data collection procedure, and sample characteristics. Details of the studies are given to ensure the quality of data used in the current secondary analysis, and to show the differences between the three primary studies and the current study.

Primary Study 1

The first primary study was a descriptive correlational study (McDougall, Holston, & Wilke, 2001) that investigated several variables to predict memory performance in older adults. The study was supported by the NIH-NINR Grant R15 NR0420. The IRB approval of the study was obtained from the Case Western

Reserve University in Ohio. The specific aims of this study were (1) to examine the association between metamemory and memory performance among the elderly; (2) to examine the effects of health, depression, and self-efficacy beliefs on the relationships between memory performance and metamemory; and (3) to examine the effects of age, gender, race, and education of the elderly on the relationships between memory performance and metamemory.

The recruiting process was started by purchasing a random zip code list of adults, aged 70 or older, living in Cuyahoga County, Ohio. Before face-to-face interviews with individuals in their homes, a four-phase telephone screening process was used to determine subjects' eligibility for the study. The purpose of implementing the four-phase telephone screening process was to eliminate anxiety and stress among individuals who might be ineligible for study inclusion because of early or mild cognitive impairment.

The first telephone call screened subjects' eligibility using language, age, race, and living arrangement. Subjects were eligible if they were able to speak English, 70 years of age or older, African-American or Caucasian, and not living in a nursing home. All individuals participating in this primary study were living in the community in private homes, subsidized high-rise apartments, or assisted living facilities. During the second telephone call, an interviewer asked whether an individual was interested in participating in a study of memory and health. If the individual was willing to participate in the study, a flyer containing descriptions of the study and a consent form was mailed to the individual. During the third telephone call, if interest and informed consent were affirmed, the

interviewer administered the Short Portable Mental Status Questionnaire (SPMSQ: Pfeiffer, 1975) to detect intellectual impairments in older adults. To be included in the primary study, individuals had to score 8 or more out of a total score of 10, indicating intact cognitive functioning. When administering SPMSQ over the telephone, a trained research assistant followed a written script to reduce bias. The results were not disclosed at the time of the telephone call. The individual was thanked for his or her participation and mailed a \$2 grocery coupon. The fourth telephone call was made to individuals with intact cognitive functioning screened by SPMSQ. During the fourth call the individual was informed that he or she was qualified for a complete home interview. If the contacted individual was interested in doing a home interview, the individual's home address was confirmed and a home interview date was scheduled.

A trained interviewer conducted a face-to-face interview in a participant's home. Before starting data collection, an interviewer read the letter of consent to a participant, and took time to discuss the participant's concerns or questions. The MMSE was first administered to assure that individuals with cognitive impairments were not missed by the SPMSQ. While SPMSQ has the ability to screen out seriously impaired subjects, it is not sensitive enough to screen out mild cognitive impairment. Next, subjects were asked to complete a packet of questionnaires. The age of the sample ($N = 172$) ranged from 70 to 93 ($M = 76.51$, $SD = 5.16$), and the level of education ranged from 3 to 25 years ($M = 11.67$, $SD = 3.20$) (see Table 3.1).

Primary Study 2

The second primary study was a quasi-experimental study (McDougall, 2002) testing effectiveness of an eight-session intervention designed to improve both subjective and objective memory in the elderly. This study was supported by the Claude D. Pepper Older Americans Independence Center at Case Western Reserve University Medical School. The IRB approval of the study was obtained from the Case Western Reserve University. A total of 78 participants (58 women, 20 men) were recruited from a retirement community in Cleveland, Ohio. The sample's average age was 82 years, with an average education level of 16 years.

To recruit study participants, the principal investigator and an instructor gave two 30-minute presentations during Friday morning coffee-hour socials. During the presentations they had time to enlist participants, answer questions, and discuss concerns about the study. After the presentations, sign-up sheets were distributed, and interested individuals were scheduled for pre-testing.

At the time of the pre-testing, consent was obtained by trained interviewers or the principal investigator, and a copy of the consent form was given to each participant. After participant's consent was obtained, the MMSE was administered, not to screen out participants with cognitive impairments, but to determine participants' baseline levels of cognitive function. The sample ($N = 78$) scored an average MMSE score of 28. Participants then completed a packet of questionnaires. Finally participants were administered the RBMT, and paid with 20\$ value grocery coupons.

Among the 78 subjects, only 32 subjects were included in the current study because of completeness of data and the eligibility criteria for the current secondary analysis. The age of the 32 subjects ranged from 66 to 94 ($\underline{M} = 81.03$, $\underline{SD} = 8.24$), and their level of education ranged from 8 to 20 years ($\underline{M} = 14.44$, $\underline{SD} = 2.57$) (see Table 3.1).

Primary Study 3

The third study was a quasi-experimental study (McDougall, 2001) conducted at a 175-bed county nursing home in northeastern Ohio. The purpose of the study was to improve or prevent decline in memory self-efficacy and memory performance in the frail elderly by presenting an eight-session intervention. There was no control group. This study was supported by the American Nurses and Rehabilitation Nurses Foundation. The IRB approval of the study was obtained from the Case Western Reserve University in Ohio.

All residents of the nursing home were eligible to participate in this primary study if they were able to give informed consent. At the time of the first interview, the study was fully explained to the individual, and his or her concerns or questions were answered. Each individual then signed a consent form. The participants' baseline cognitive function was assessed using the MMSE which was administered by a Master's-prepared Gerontological nursing researcher. The study participants' MMSE scores ranged from 10 to 30 ($\underline{M} = 22.03$, $\underline{SD} = 4.56$). Following the administration of the MMSE, a packet of questionnaires was administered to all eligible participants by Master's-prepared nurse data collectors. Each interview was on a one-to-one basis in a subject's room in

privacy. Interviews were interrupted when subjects needed time to rest. Each interview took approximately 60 to 120 minutes to complete. A total of 30 subjects participated in the study. The average age was 73.09 (SD = 7.61) for the 13 subjects who completed post-intervention tests, and 73.00 (SD = 17.54) for the 17 dropouts of the study before completing the study intervention. The current secondary analysis included data from 27 subjects from this third primary study participants. The age of the 27 subjects ranged from 67 to 97 (M = 81.52, SD = 8.37), and their level of education ranged from 5 to 20 years (M = 13.12, SD = 4.55) (see Table 3.1).

Table 3.1: Demographic Characteristics of Sample in the Current Study.

Characteristics	Source of the Sample			Total (<u>N</u> = 231)
	Primary	Primary	Primary	
	Study 1 (<u>n</u> = 172)	Study 2 (<u>n</u> = 32)	Study 3 (<u>n</u> = 27)	
Age				
<u>M</u>	76.51	81.03	81.52	77.72
<u>SD</u>	5.16	8.24	8.37	6.42
Range	70 – 93	66 – 94	67 – 97	66 – 97
Education				
<u>M</u>	11.67	14.44	13.12	12.22
<u>SD</u>	3.20	2.57	4.55	3.44
Range	3 – 25	8 – 20	5 – 20	3 – 25
Gender				
Female	116	23	23	162
Male	56	9	4	69
Race				
African-American	89	1	5	95
Caucasian	83	23	8	114
Missing	-	8	14	22

CURRENT STUDY VS. PRIMARY STUDIES

This study proposes research questions unique in three ways as compared to the primary studies. The uniqueness of the current study is important to address because, by definition, a secondary analysis uses “data that have been collected by

other people for other purposes” (Knapp, 1998, p. 193). First, as can be seen from the Predictive Model of Everyday Memory Performance (see Figure 3.1), the construct of health was used as a mediator variable between metamemory and memory performance in three primary studies. In the current study the construct is used as a predictor of cognitive functions such as cognition, memory performance, and metamemory. In the three primary studies, eight health profile scores in SF-36 were computed and utilized in various analyses. In the current study two summary scores are computed, and analyzed. This summary scaling method is introduced for the first time in cognitive studies to investigate the summary scores’ predictability of cognitive function. Finally, the current study assesses older adults’ health status using the 12-item version of SF-36, and compares psychometric characteristics between the two health measures, SF-36 and SF-12. The SF-12 consists of 12 items extracted from the 36 items in SF-36. As such, this secondary analysis addresses research questions and methods that were not proposed in the three primary studies.

INSTRUMENTATION

This study employs five instruments. The five instruments are Medical Outcomes Study Short Form 36-item Health Survey (SF-36), Medical Outcomes Study Short Form 12-item Health Survey (SF-12), Mini-Mental State Examination (MMSE), Rivermead Behavioural Memory Test (RBMT), and Metamemory in Adulthood questionnaire (MIA). The data for SF-12 were available for this study without administering the instrument to subjects. Since 12 items in SF-12 comes from SF-36, data for SF-12 were extracted from data

measured with SF-36. This section describes instruments' development, scoring, and psychometric properties.

SF-36

The Medical Outcomes Study Short Form 36-item Health Survey (SF-36) measures health status in adults aged 14 or older (Ware & Sherbourne, 1992). SF-36 has two versions. The first version is the original SF-36, and the second version has some items with modified wordings and changed selection choices. There are two forms in each version: acute and standard. The acute form asks persons to rate health compared to one week ago; while the standard form asks for four-week reference. The older adult's health status in the current study was measured using the acute form of the first version of SF-36.

The SF-36, as a generic measure, taps "health concepts that represent basic human values that are relevant to everyone's functional status and well-being" (Ware, Snow, Kosinski, & Gandek, 1993, p.2:3). A generic measure is useful in monitoring patients with multiple conditions, comparing groups of patients with different conditions, and comparing patients to the general population. Since SF-36 is applicable to a wide range of types and severities of conditions, it is useful in health policy evaluations, general population surveys, clinical practice, and research (McHorney, Ware, Lu, & Sherbourne, 1994).

The SF-36 was developed in the 1970's by the Rand Corporation as part of the Medical Outcomes Study, and immediately used as an outcome measure for its Health Insurance Experiment which compares the impact of various health insurance systems on health status and utilization (Brook et al., 1983; Valdez et

al., 1989; Ware, Snow, Kosinski, & Gandek, 1993; Ware et al., 1986). The outcome measure was later refined, and used with older and sicker people, including elderly in the Medical Outcomes Study (MOS). The outcome measure used in the MOS assessed 40 physical and mental concepts. The lengthy MOS measure was shortened into a 18-item measure (Montgomery & Paranjpe, 1985; Ware, Sherbourne, & Davies, 1992), and later into a 20-item measure (Stewart, Hays, & Ware, 1988; Ware, Sherbourne, & Davies, 1992). The 20-item MOS measure was criticized for being too brief to be able to be sensitive to changes in health status (Bindman, Keane, & Lurie, 1990). In response to the critics, SF-36 was designed after adding and changing items in the 20-item MOS measure (Ware & Sherbourne, 1992; Ware, Snow, Kosinski, & Gandek, 1993).

The SF-36 measures eight concepts of self-reported health; 1) Physical Functioning, 2) Role limitations due to Physical problems, 3) Bodily Pain, 4) General Health, 5) Vitality, 6) Social Functioning, 7) Role limitations due to Emotional problems, and 8) Mental Health. Each item has a Likert type response set, and raw score for each subscale is computed from a corresponding number of items. The eight raw scores are transformed to standard scores, ranging 0 to 100, with 0 being the lowest potential score attainable and with 100 being the highest. A higher score indicates a better health status (Ware, Snow, Kosinski, & Gandek, 1993).

Ware, Snow, Kosinski, and Gandek (1993) summarized reliability coefficients of eight subscales in SF-36 reported in 14 studies. The coefficients were estimated with Cronbach's alpha, test-retest, or alternate-form method. The

median of alpha coefficients from each scale were equal to or greater than .80 across studies with the exception of the Social Functioning scale which had median reliability coefficient of .76. The Physical Functioning scale was the only scale which consistently had reliability coefficients of more than .90 across 14 the studies. Patient populations and situations represented in those studies are diverse.

Brazier and his colleagues (1992) reported 2-week period test-retest reliability coefficients and internal consistency reliability coefficients, based on the general population in the United Kingdom. The test-retest reliability coefficients ranged from .60 to .81 with a median of .76. The internal consistency reliability coefficients of the eight scales ranged from .73 to .96, with a median of .95.

McHorney, Ware, Lu, and Sherbourne (1994) reported the internal consistency reliability of SF-36 scale scores from participants in the Medical Outcomes Study ($N = 3,445$), aged 18 or older. The subgroups differed in sociodemographic characteristics, diagnosis, and disease severity. The alpha coefficients ranged from .78 to .92 in older adults aged from 65 to 74, and the coefficients ranged from .77 to .92 in older adults aged 75 or older. The alpha coefficients from the current study sample were .92 for Physical Functioning, .86 for Role Physical, .84 for Bodily Pain, .69 for General Health, .81 for Vitality, .76 for Social Functioning, .83 for Role Emotional, and .79 for Mental Health.

The validity of SF-36 was demonstrated by various empirical approaches such as criterion-based approaches, factor analysis, and correlation analysis (Ware, Snow, Kosinski, & Gandek, 1993). First, criterion-based interpretation of

SF-36 scale scores was done by examining subscale scores in relation to scores on a criterion. For example, Physical Functioning (PF) scores from the general U.S. population ($N = 2,192$) were compared with the participants' ability to work. The percentage of the participants who cannot work because of health problems increased as PF scores decreased from 100 to 0. Ware et al. (1993) described similar analyses for other health profile scales.

The validity of SF-36 was explained in several factor analysis studies (McHorney, Ware, & Raczek, 1993; Ware, Gandek, & the IQOLA Project Group, 1994; Ware, Keller, Gandek, Brazier, Sullivan, & the IQOLA Project team 1995; Ware, Snow, Kosinski, & Gandek, 1993). In a factor analysis study by McHorney, Ware, and Raczek (1993), a two-factor orthogonal solution accounted for 82.4 % of the variance. This represented the two health dimensions in SF-36 (physical health and mental health) that were confirmed in previous studies (Hays & Stewart, 1990; Ware, Davies-Avery, & Brook, 1980).

Ware et al. (1993) summarized a number of studies that have considered the validity of the SF-36 using correlation analysis. Correlations between General Health scale and the other subscales in SF-36 ranged between .43 for Role Emotional scale and .69 for Physical Functioning and Role Physical scales. Correlations of the eight health scales in SF-36 with a criterion measure of quality of life were examined, and the correlations were all significant, and positive, ranging from .19 to .60 (Ware, Snow, Kosinski, & Gandek, 1993).

To interpret SF-36 scale scores, one need to consider two important attributes of health that are related to validity (Ware, 1987). The two attributes in

the construct of health are dimension and range. First, health is believed to have two dimensions in general; physical and mental. The Physical Functioning scale is the most valid measure of the physical component of health status, while the Mental Health scale is the most valid measure of the mental component of health status. The other six scales fall in between Physical Functioning and Mental Health, in terms of their relationship to physical or mental health. The three most valid measures of physical component of health are Physical Functioning, Role Physical, and Bodily Pain. Social Functioning, Role Emotional, and Mental Health are valid in measuring the mental component of health. Vitality and General Health are sensitive to both physical and mental health outcomes (Ware, Snow, Kosinski, & Gandek, 1993).

Secondly, validity is discussed in relation to the range in which the eight scales in SF-36 are measuring both limitations and well-being. A measure of health needs to encompass a full range of states from disability to well-being (Ware, 1987). General Health, Vitality, and Mental Health measure both limitations and well-being. For these scales, mid-range scores on the 0 to 100 scale mean that subjects have no limitation, while scores close to 100 mean that subjects have a high level of well-being as well as no limitation. For the other subscales, the highest potential score of 100 mean the absence of negative health states such as limitation, disability, or pain (Ware, Snow, Kosinski, & Gandek, 1993).

PCS36 and MCS36

In SF-36, there are the two summary measures: physical component summary measure (PCS36) and mental component summary measure (MCS36). Support for the two constructs comes from factor analytic studies (McHorney, Ware, & Raczek, 1993; Ware, Gandek, & the IQOLA Project Group, 1994; Ware, Keller, Gandek, Brazier, Sullivan, & the IQOLA Project team 1995; Ware, Snow, Kosinski, & Gandek, 1993). These studies reported that two components accounted for 80 to 85 percent of the variance in the eight scale scores in SF-36.

Scores of PCS36 and MCS36 are computed by weighting and summing standardized scores on the eight health scales from SF-36. These weights were determined from factor analysis of data from a general U.S. population. That is why the two scales are referred to as component measures (Ware & Kosinski, 2001). Each of the eight subscale scores is differentially weighted for PCS36 and MCS36. For example, the scales of physical functioning, role-physical, and bodily pain receive greater weight to compute PCS36 than do other scales related to mental aspects, and vice-versa in case of computing MCS36 (Ware, Kosinski, & Keller, 1994).

There are three steps to compute two summary measure scores from the eight scale scores in SF-36. First, the standardized scores on the eight scales are transformed to *z*-scores so that the eight scale scores have the same means and standard deviations from the normative sample, which is representation of the 1990 general U.S. population. The second step is to compute aggregate scores for PCS36 and MCS36 using the physical and mental factor score coefficients from

the 1990 general U.S. population. Lastly, a linear T-transformation is done so that each of PCS36 and MCS36 scores has a mean of 50 and a standard deviation of 10 (Ware & Kosinski, 2001).

The two summary measures are useful when there is a need to limit the number of outcomes being analyzed, and/or when a general effect across eight subscales, in the physical or mental health domain, is expected. A major advantage of using the two summary measures is that scores of the summary measures range more widely than do the eight subscale scores. Individuals rarely score at the very top or very bottom of the summary measures (Ware & Kosinski, 2001).

The PCS36 and MCS36 have high content validity, meaning that scores can be interpreted largely in terms of the content of eight scales in SF36. Health status measured with PCS36 involves the level of limitations in self-care and role activities, bodily pain, energy or tiredness, and a self-rating of health from poor to excellent. In contrast, health status measured with MCS36 involves the level of psychological distress, limitations in social/role activities due to emotional problems, and a self-rating of health from poor to excellent (Ware & Kosinski, 2001; Ware, Kosinski, & Keller, 1995).

Reliability in PCS36 and MCS36 was examined using the survey data from general populations in ten European countries. The alpha coefficients ranged from .90 to .94 for PCS36, and from .85 to .90 for MCS36. These high values suggested that the underlying two health dimensions can be reliably scored by summing scores of eight scales in SF-36 from general populations (Ware &

Kosinski, 2001). The alpha coefficient from SF-36 normative sample, age ranged from 65 to 74, was .93 for PCS36, and .85 for MCS36. The alpha coefficient from the sample aged 75 or older was .91 for PCS36, and .89 for MCS36. Internal consistency reliability coefficients were also estimated from the current study sample, with a .90 for PCS36, and .86 for MCS36.

SF-12

The Medical Outcomes Study Short Form 12-item Health Survey (SF-12) is developed to be a shorter, yet valid, alternative to SF-36 for diverse purposes across general and specific populations. With data collected using SF-12, it is possible to compute scores for an individual on two summary measures. The two summary measures from SF-12 are physical component summary measure (PCS12) and mental component summary measure (MCS12). The 12 items are sampled from 36 items in SF-36 (Ware, Kosinski, & Keller, 1995).

The development of SF-12 is a response to the concern that SF-36 is too long to use for measuring and monitoring health in large-scale health studies, although it has been proven that the measure is psychometrically sound and useful for diverse purposes (Ware, Kosinski, & Keller, 1996). Meanwhile, the two findings regarding performance of the two factor components in SF-36 initiated the study to reproduce the eight scales in SF-36 with fewer items. The first finding was that two factors (physical and mental) accounted for almost 85 percent of the variance in the eight scale scores from SF-36. The two-factor solution also successfully differentiated groups known to differ in terms of age, diagnosis, severity of disease, comorbid conditions, acute symptoms, self-reported

changes in health, and recovery from clinical depression. These findings showed the possibility of reproducing SF-36 results with fewer numbers of items without losing information (Ware, Kosinski, & Keller, 1994; Ware, Kosinski, Bayliss, McHorney, Rogers, & Raczek, 1995).

Using regression methods, Ware et al. (1995, 1996) selected 12 items from SF-36, and scored those items to reproduce scores of PCS36 and MCS36 in the general U.S. population ($N = 2,333$), 18-years old or older. In SF-12, Physical Functioning, Role Physical, Role Emotional, and Mental Health have two items each, while Bodily Pain, General Health, Vitality, and Social Functioning have only one item each. The SF-12 explained more than 90 percent of the variance in two summary measure scores from SF-36, and took less than 2 minutes to be completed by either self-administration or interviewer administration (Ware, Kosinski, & Keller, 1996).

Scores of PCS12 and MCS12 are correlated with the scores of two summary measures from SF-36 in the range from .93 to .97 in cross validation studies. The 2-week test-retest reliability coefficients were .89 for PCS12, and .76 for MCS12 ($n = 232$). Ware and colleagues (1996) examined how the two summary measures in SF-12 discriminated six known groups. The results were comparable with those from SF-36. However, PCS12 and MCS12 discriminated group differences, as do two summary measures in SF-36, but with relative validity almost 10 percent lower than observed in SF-36 (Ware, Kosinski, & Keller, 1996).

PCS12 and MCS12

The SF-12 produces two summary measures called physical component summary measure (PCS12) and mental component summary measure (MCS12) as the SF-36 does. Scores of the two summary measures in SF-12 are computed using regression weights and a constant. Each of the physical and mental summary component scores uses different sets of weights and a different constant. Those weights and constants came from a normative sample that is representative of general U.S. population in 1990. The aggregated scores are transformed to have a mean of 50 and a standard deviation of 10. This process of standardization and norm-based scoring of SF-12 physical and mental summary measure scores allows for comparison of results between groups, and interpretation of scores in relation to the distribution of scores in the general U.S. population.

Scoring PCS12 and MCS12 involves four steps. The first step involves eliminating out-of-range values and reverse-scoring four items so that a higher score indicates better health. The second step is to create indicator variables (scored 1 or 0) for the item response choice categories. The third step involves weighting the indicator variables using regression coefficients from the normative sample and aggregating the weighted variables. The last step is standardizing the aggregated SF-12 physical and mental scores by adding a constant (Ware, Kosinski, & Keller, 1995).

The choice of which measure (SF-36 or SF-12) to use in a specific situation involves several considerations. The first is to decide which is more important, the respondent burden or the precision of scale scores (“Comparisons

among”, n.d.). It takes approximately 10 minutes to complete SF-36, and about 2 minutes to complete SF-12. Both instruments measure the same eight concepts of health, but SF-36 may better represent each of eight health concepts because it has more items in each scale. The content of the two instruments is comparable since SF-36 and SF-12 share 12 items with identical wording and response categories. Both instruments also produce two summary measures, however, SF-12 does not produce eight health profile scores (Ware, Kosinski, & Keller, 1996). The second version of SF-12 can produce eight scale scores, but this study uses the first version of SF-12. The choice between SF-36 and SF-12 is largely practical and depends on study objectives (“Which SF survey”, n.d.). Even though SF-12 is shorter than SF-36, the summary scores from SF-12 appear to adequately reproduce those from SF-36. However, it is unknown whether the performance of SF-36 and SF-12 would be comparable when the measures are used to predict cognitive function in older adults.

Mini-Mental State Examination (MMSE)

The Mini-Mental State Examination (MMSE: Folstein, Folstein, & McHugh, 1975) is a screening measure of cognitive impairments. In two of primary studies (McDougall, 2001; McDougall, Holston, & Wilke, 2001), MMSE was used to rule out subjects with cognitive impairments at initial recruiting stage. In the current study, MMSE scores are used as one of the cognitive function variables since MMSE is sensitive enough to detect cognitive changes, particularly in the elderly (Cummings, 1993), and memory measured with MMSE is an important aspect of cognitive function (Tombaugh & McIntyre, 1992).

When mental status exams are needed to rule out subjects with cognitive impairments, a shorter exam is more often preferred to a lengthier one. As an example of a lengthy comprehensive mental status exam, the standard Wechsler Adult Intelligence Scale (WAIS) takes more than 30 minutes to administer and score. The MMSE takes only five to ten minutes to administer, although the test includes 30 questions assessing cognitive functioning in five areas: orientation, registration, attention and calculation, recall, and language. Registration and recall specifically assess memory functions. Potential MMSE scores range from 0, meaning completely impaired, to 30.

Folstein and colleagues (1975) using a single test administrator reported a fairly high test-retest reliability coefficient of .89 in 24-hour period ($p < 0.0001$), and .99 in 28-day period ($p < 0.0001$). When two testers administered MMSE to 19 depressive patients twice in a 24-hour period, the Pearson r was .83 ($p < 0.0001$). Tombaugh and McIntyre (1992) reviewed literature regarding the psychometric properties and utility of MMSE, and reported that, overall, the level of reliability, both internal consistency and test-retest, was in an acceptable range, though two findings were notable. First, the alpha coefficient was higher with patients with medical problems than with community living elderly aged 70 or older. This was not an unexpected finding. When MMSE was used with a group of community-living elders, the variability of total scores was limited because the elders were able to give correct answers to most of the MMSE items, hence decreasing the likelihood of obtaining a high alpha coefficient. Second, several studies reported low alpha coefficients, though these findings may be meaningful,

as well. Since MMSE is designed to assess various cognitive functions, items in MMSE are heterogeneous to each other to some degree (Crum, Anthony, Bassett, & Folstein, 1993), and hence the internal consistency of the MMSE items may be limited.

The test-retest method is a standard procedure to assess the reliability of MMSE than Cronbach's alpha method. In the current study MMSE scores are available for one time measurement only, hence the test-retest method cannot be used to check the reliability of MMSE with this group of older adults. The MMSE scores in the current study do not include the full range of potential scores, but scores of 23 or higher only. Estimating alpha coefficients with the truncated range of MMSE scores may not be a proper way to assess the internal consistency reliability with this sample.

The MMSE scores successfully discriminated three groups of people with different diagnosis from one another, and from non-impaired people (Folstein, Folstein, & McHugh, 1975). The mean MMSE score was 9.7 for dementia patients, 19.0 for depressive patients with cognitive impairments, 25.1 for patients with uncomplicated affective disorder, and 27.6 for normal people. With age-matched grouping of subjects, Folstein and colleagues (1975) found the same dispersal of mean scores between groups. Concurrent validity was demonstrated by correlating MMSE scores with scores from a standard test of cognition, the Wechsler Adult Intelligence Scale: The correlation between MMSE scores and Verbal IQ scores was .776 ($p < 0.0001$), and the correlation between MMSE scores with Performance IQ scores was .660 ($p < 0.001$).

For individual with more than eight years of education, an MMSE score of less than 23 is an evidence of cognitive impairment, though additional comprehensive evaluation is required before making such diagnosis (Folstein, 1983). Some researchers suggest using MMSE score of 17 as the cut-off score for deciding cognitive impairment when subjects have less than eight years of education (Murden, McRae, Kaner, & Bucknam, 1991). Only seven percent of the sample ($n = 16$) in the current study were educated less than eight years, and they all scored 23 or more on MMSE.

Rivermead Behavioural Memory Test (RBMT)

The Rivermead Behavioural Memory test (RBMT) is the second cognitive function test administered to the older adults in the current study. The RBMT has four forms (A, B, C, and D) and each form has the same 12 components in different order. The components and corresponding raw scores (in parenthesis) are remembering names (4), remembering a hidden belonging (4), remembering an appointment (2), picture recognition (10), remembering a newspaper article (21), face recognition (5), remembering a new route immediately (5), remembering a new route delayed (5), delivering a message (6), orientation (9), and date (1).

Detailed descriptions of each component follow. First, remembering a person's name is tested by associating a first name and surname with a photograph of a face. This is done by requiring recall of the first name and surname when the photograph is re-presented later in the test session. Next, items assess memory for common objects and faces by using a recognition paradigm.

For both subtests, subjects are required to process the to-be-remembered material and then after a delay, recognize the original items from among an equal number of distracters, with each being presented individually. Two other items test both immediate and delayed recall. A short paragraph, similar to a news item, is read to a subject. Immediately the person is asked to repeat as much as can be remembered. After a 20-minute interval, delayed recall of the passage is requested. Similarly, a route around the room is demonstrated and copied immediately by the subject. After a 15-minute interval, delayed recall of the route is requested. There are three measures of prospective memory: remembering at the end of the session to ask for a personal possession that was put away at the beginning of the session; remembering when an alarm rings to ask a specific question given when the alarm was set 20 minutes earlier; and remembering to take a message on the route around the room and deliver it at a specific point along the route. There are also items to test orientation in time, place, and person.

There are three RBMT scores for each subject. The first is a raw score for each individual component. The second is a standard profile score with a maximum of 24. Each component gets a score of two for perfect performance, one for a single error, and zero for errors in excess of one. Finally there is a screening score with a maximum of 12. The score of one is assigned in each component successfully completed; otherwise, zero is assigned. The transformation of raw score into either standard profile score or screening score is a necessary step to assign the same weight to each component, and to compute a total score for an individual. The current study computed and analyzed standard

profile scores of RBMT. Generally, memory function is considered normal at a standard profile score of 22 or higher. The cut-off point of 22 is based on RBMT data from 118 subjects who have a mean age of 41.17 (age ranged from 16 to 69), and a mean IQ of 106 (IQ ranged from 68 to 136), and with no brain-damage (Wilson, Cockburn, Baddeley, & Hiorns, 1989).

Wilson, Cockburn, Baddeley, and Hiorns (1989 & 1991) reported evidence of reliability and validity for RBMT using two groups of people; 175 brain-damaged patients and 118 normal subjects as a comparison group, reporting interrater reliability coefficients for 40 subjects. Each subject was interviewed by two raters simultaneously. Ten raters took part in the interrater reliability test. There was 100 percent agreement between the 10 raters for both screening and profile Scores. The alternate-form reliability coefficient was estimated using 118 subjects. All subjects completed form A and were divided into three groups, with each group completing either form B, C, or D. The coefficients of screening scores from form A with screening scores from form B, C, and D were .84, .80, and .67 respectively. The coefficients of profile scores from form A and with profile scores from form B, C, and D were .86, .83, and .88 respectively. The alternate-form reliability coefficient was low at .67 between form A and form D when screening scores were used. This implies that profile scores may be a more reliable estimation of older adults' memory performance. The test-retest reliability using Pearson correlation was .78 with screening scores, and .85 with profile scores, using the same 118 subjects. The internal consistency reliability of RBMT with the current study sample was .72.

The evidence for the validity of the RBMT is considerable (Wilson, Cockburn, Baddeley, & Hiorns, 1989 & 1991). First, standard profile scores were correlated with scores from other memory measures such as the Warrington Recognition Memory Test (Warrington, 1984) for words, a subtest from Randt Memory Test (Randt, Brown, & Osborne, 1980) for faces, digit span, spatial span, the paired-association, and the Collins and Quillian sentence verification task (Baddeley, 1981). Correlations ranged from .20 to .63. Low correlations may be related to the fact that RBMT measures memory skills needed in everyday life, while the criterion measures focus on basic laboratory memory tasks. Broadly speaking, correlations showed that RBMT can be regarded as a memory performance measure.

Wilson et al. (1989 & 1991) examined correlations between RBMT scores from 80 brain-injured patients and the number of memory lapses. Occupational therapists or physiotherapists completed a checklist asking memory failures in 19 areas. Each patient was observed a mean of 35 hours. The number of memory lapses was correlated at $-.71$ with RBMT screening scores, and $-.75$ with RBMT profile scores. Correlations between the number of memory lapses and scores from other standard memory tests were smaller, ranging from $-.68$ to $-.09$. The RBMT as an everyday memory performance was supported. Overall RBMT appears to be a valid and reliable measure of everyday memory performance.

Metamemory in Adulthood Questionnaire (MIA)

The third instrument assessing cognitive function in the elderly is the Metamemory in Adulthood questionnaire (MIA) which is a 108-item, 5-point

Likert scale. The MIA was developed by Dixon and Hultsch (1983a, 1983b, & 1984) to measure metamemory in adults. Each item reflects “everyday, ecologically relevant activities, behaviors, or conditions” (Dixon, 1992, p.405). Subjects were asked to rate between 1 to 5 on statements describing their memory functioning and their knowledge of general memory processes (Dixon, Hultsch, & Hertzog, 1988). The 108 items are grouped into seven subscales designed to represent multidimensional aspects of metamemory construct. The seven subscales are Achievement, Anxiety, Capacity, Change, Locus, Strategy, and Task. Table 3.2 shows item number consisting in each scale and description of what each scale assesses.

The psychometric characteristics of MIA were examined with 10 samples totaling more than 2,000 individuals with age ranging from 18 to 84 years (Dixon, Hultsch, & Hertzog, 1988). The alpha coefficients were estimated with 5 different samples. The coefficient range was .76 to .79 for Achievement, .83 to .87 for Anxiety, .81 to .86 for Capacity, .90 to .93 for Change, .71 to .78 for Locus, .82 to .86 for Strategy, and .78 to .83 for Task. The alpha coefficients for seven subscales in MIA for the sample used in the current study are .69 for Achievement, .82 for Anxiety, .84 for Capacity, .88 for Change, .70 for Locus, .82 for Strategy, and .71 for Task.

Table 3.2: Information of Subscales in MIA.

Subscale	Items	Description
Achievement	16	Perceived importance of having a good memory and performing well on memory tasks. High score means high level of motivation to achieve good memory.
Anxiety	14	Rating of the influence of anxiety and stress on performance of cognitive tasks. High score means high level of anxiety.
Capacity	17	Perception of memory capacities as evidenced by predictive report of performance on given tasks. High score means high level of reported memory capacity.
Change	18	Perception of memory abilities as generally stable or subject to long-term decline. The higher the score, the more stable memory is.
Locus	9	Perceived personal sense of control over remembering skills. High score means high level of internality.
Strategy	18	Knowledge of one's remembering abilities such that performance in given instances is potentially improved; reported use of mnemonics, strategies, and memory aids. High score means high use of memory aids.
Task	16	Knowledge of basic memory processes, especially as evidenced by how most people perform. High score means high level of understanding of general memory Processes.

Note. Adapted from “Questionnaire research on metamemory and aging: Issues of structure and function” by R. A. Dixon, 1992, p. 405.

The evidences of convergent validity were suggested in several studies by correlating subscale scores in MIA with indicators from Memory Functioning Questionnaire (MFQ: Gilewski, Zelinski, Schaie, & Thompson, 1983; Zelinski, Gilewski, & Thompson, 1980). The evidence of discriminant validity was suggested by correlations between MIA subscales and other measures such as generalized locus of control, state or trait anxiety, depression, or concurrent depressive affect. The range of correlation coefficients was from .003 to .438 (Hultsch, Hertzog, Dixon, & Davidson, 1988). Criterion-related validity was suggested by having low to moderate correlations ($r = .23$ to $.47$) between MIA subscales and various cognitive measures in a group of women aged between 21 and 78 (Dixon & Hultsch, 1983a; Dixon, Hertzog, & Hultsch, 1986).

ANALYSES

Data management and analysis were done using the SPSS® 10.0.1 statistical software program. A total of 231 subjects who met the eligibility criteria for the current study were selected from an existing data file and included in the current secondary analysis study.

Data Management

Before analysis of data, the range of data for each variable was examined to see if there were any out-of-range values; none were found. Next, internal consistency reliability for each instrument was assessed (reported earlier under the instrumentation section). The Cronbach's alpha coefficients for all instruments were acceptable, ranging from .69 to .92.

Missing data in SF-36 data were handled as specified in the instrument's manual (Ware, Snow, Kosinski, & Gandek, 1993). If a subject answered half or more than half of the items in a scale for SF-36, missing responses in the scale were replaced with an average of the answered responses for that scale. If a subject had missing data on more than half of the items in a scale on the SF-36, the scale score for the subject was not computed.

No missing data were found in variables measured with MMSE and RBMT. These two objective measures of cognitive function were administered and scored by trained interviewers. Missing data in variables measured with MIA were handled as the developers of the instrument recommend. A scale mean was entered into missing cells with a maximum of two substitutions for Achievement, Anxiety, Locus, and Task, and three substitutions for Capacity, Change, and Strategy. After all missing data were handled according to specified guidelines, scale scores were computed.

Finally, distribution of scores in each study variable was examined using histogram analysis. The histograms for all variables suggested relatively normal distributions, except for several health status variables. In addition, distribution of each scale score was again examined using indices of skewness and kurtosis (see Table 3.3), which indicate how much a distribution varies from a normal distribution. Skewness is a measure of symmetry of a distribution. Kurtosis is a measure of peakedness of a distribution, suggesting the extent to which scores cluster around a central point. A perfectly normal distribution results in the value of 0 for both skewness and kurtosis. When the values of skewness and kurtosis

from a set of data do not exceed 1.0, the distribution of scores is considered approximately normal (Huck & Cormier, 1996).

Table 3.3: Skewness and Kurtosis of Data.

Instrument	Subscales	Skewness	Kurtosis
SF-36	Physical Functioning	-.23	-1.18
	Role Physical	-.43	-1.48
	Bodily Pain	-.52	-.64
	General Health	-.20	-.55
	Vitality	-.36	-.50
	Social Functioning	-1.28	.38
	Role Emotional	-1.56	.93
	Mental Health	-1.22	1.17
	PCS36	-.39	-.61
	MCS36	-1.16	1.16
SF-12	PCS12	-.33	-.80
	MCS12	-1.14	.94
MMSE	Cognition	-.49	-.84
RBMT	Memory Performance	-.79	.50
MIA	Achievement	.03	.16
	Anxiety	.04	-.41
	Capacity	-.14	.20
	Change	.20	-.15
	Locus	-.14	-.04
	Strategy	-.27	-.37
	Task	.29	.79

The indices of skewness and kurtosis on each scale score from the study participants were relatively small in most cases, except for Role Physical and Role Emotional. However, West, Finch, and Curran (1995) assert that non-normality is not severe unless the skewness index is larger than 2 or the kurtosis index is larger than 7. Therefore, all scale scores in the current study were assumed to have roughly normal distributions.

Data were analyzed using both descriptive and inferential statistics to address the five research questions proposed in Chapter one. The alpha level in the current study was set at .05, whereas otherwise specified, to determine statistical significance.

SUMMARY

The current secondary data analysis used data extracted from an existing data file representing three primary studies. A total of 231 subjects met the inclusion criteria for this study. Using a statistical software program, data from the 231 subjects were checked for errors, missing data, and distribution of scores. Instruments utilized to measure study variables were introduced in detail, and their internal consistency reliabilities were assessed. The specific analysis for each research question, results, and findings are presented in the following Chapter.

CHAPTER 4: RESULTS

This chapter presents a description of the study sample followed by data analysis for each research question, and its results and findings.

DESCRIPTIONS OF SAMPLE

From an existing data file, data from 213 subjects who met the inclusion criteria for this current study were selected. The criteria for study participants were 1) aged 65 or older, 2) African-American or Caucasian, 3) able to read and speak English, or using English as a primary language, and 4) without any cognitive impairment.

Of the 231 older adults, 162 (70.1 %) were females and 69 (29.9 %) were males. A total of 114 (49.4 %) subjects were Caucasians, and 95 (41.1 %) were African-Americans. Race of 22 (9.5 %) subjects was not known. Subjects' age ranged from 66 to 97 years ($M = 77.72$, $SD = 6.42$), and their level of education ranged from 3 to 25 years ($M = 12.22$, $SD = 3.44$). Between females and males, mean age was not significantly different, but mean level of education was. Males were more educated than females, $t(228) = -3.163$, $p = .002$. When t-tests were conducted between Caucasians and African-Americans on their mean age and education in years, mean age was not significantly different, but education was. Caucasians were more educated than African-Americans, $t(206) = -6.629$, $p = .000$ (see Table 4.1).

Table 4.1: Comparisons of Age and Education between Gender and Race Groups.

	Gender			Race		
	Female	Male	p ^a	Caucasian	African-American	p ^a
	(<u>n</u> = 162)	(<u>n</u> = 69)		(<u>n</u> = 114)	(<u>n</u> = 95)	
Age						
<u>M</u>	77.94	77.22	<u>ns</u>	77.86	76.44	<u>ns</u>
<u>SD</u>	6.50	6.24		6.41	5.42	
Education						
<u>M</u>	11.75	13.29	.002	13.10	10.32	.000
SD	3.27	3.60		3.17	2.79	

Note. The alpha level was set at .05. ^at-tests were conducted between groups.

The study sample was divided into two age groups based on the availability of normative data for SF-36 and SF-12. A total of 86 (37.2 %) subjects fell within the 65 to 74 age group (M = 71.53, SD = 1.92), and the rest 145 (62.8 %) fell into the 75 or older group (M = 81.39, SD = 5.21). Of the 145 subjects in the 75 or older group, 36 older adults were more than 85 years of age. Mean education in years was 12.53 (SD = 3.52) for the 65 to 74 age group, and 12.03 (SD = 3.39) for the 75 or older group. The mean education level was not significantly different between the two age groups ($t(228) = 1.081$, $p = .281$).

Marital status of the sample was as follows: 122 (52.8 %) widowed, 59 (25.5 %) married, 25 (10.8 %) divorced, 18 (7.8 %) single, and 2 (.9 %) never

married. Data on marital status from 5 (2.2 %) subjects were missing. Categories of marital status were not completely exclusive to each other. For example, a subject who selected single as his/her marital status could be either widowed, divorced, or never married. A total of 22 (9.5 %) subjects were smokers but it was not known how much they smoked per day. Regarding drinking status, 74 (32.0 %) subjects responded that they drank alcohol, but the amount of alcohol they consumed per day was not known either.

ANALYSES

Results and findings of data analyses are presented here. Before analyzing data to address each research question, correlations using the Pearson product-moment correlational method were assessed between age, education, and all study variables. The correlation matrix is presented in Table 4.2.

When correlations of age with the eight health variables in SF-36 were assessed, age was moderately correlated with Physical Functioning ($r = -.35$) and Vitality ($r = -.35$). When correlations of age with the summary measures of health were assessed, age was moderately correlated with scores of the physical component of health measures. The correlation coefficient of age with PCS36 was $-.24$, and the coefficient of age with PCS12 was $-.23$. However, age was not correlated with the mental component of health measures ($r = .03$ & $.01$ for MCS36 & MCS12 respectively).

Next, the demographic variables of age and education were correlated with cognitive function variables. Cognitive function in the elderly was measured with three instruments: two objective tests of MMSE and RBMT, and one

subjective measure of MIA. When age and education were correlated with the variable of Cognition measured with MMSE, participants showed lower Cognition scores as they age ($r = -.14$), but higher Cognition scores as they had more years of education ($r = .27$). It was noted that the correlation coefficient of Cognition with education was fairly high, even though only a limited range of Cognition scores were included in the analysis. When age and education were correlated with Memory Performance measured with RBMT, participants' performance was poorer as they aged ($r = -.33$), but improved as years of education increased ($r = .07$).

Age and education were also correlated with a subjective evaluation of cognitive function which was measured with the seven subscales in MIA. In descending order, age was significantly negatively correlated with Change ($r = -.25$), Locus ($r = -.19$), Capacity ($r = -.19$), and Anxiety ($r = .15$). Correlations of age with Achievement ($r = .06$), Task ($r = .06$), and Strategy ($r = -.02$) were weak, and not statistically significant. When education was correlated with the seven metamemory variables, moderate correlations of age were found with Task ($r = .36$), Strategy ($r = .21$), and Change ($r = -.14$), and weak correlations were found with Achievement ($r = .01$), Anxiety ($r = -.07$), Capacity ($r = -.10$), and Locus ($r = -.11$).

Table 4.2: Intercorrelations between Age, Education, and Study Variables.

		Age	Education	Physical Functioning	Role Physical	Bodily Pain	General Health	Vitality	Social Functioning	Role Emotional	Mental Health	Cognition Memory Performance	Achievement	Anxiety	Capacity	Change	Locus	Strategy	Task	PCS36	MCS36	PCS12	MCS12	
Age	r	1.00	.07	-.35	-.06	-.07	-.09	-.35	.03	.03	-.06	-.14	-.33	.06	.15	-.19	-.25	-.19	-.02	.06	-.24	.03	-.23	.01
	p	.	.27	.00	.37	.29	.19	.00	.61	.68	.40	.05	.00	.34	.03	.01	.00	.00	.82	.41	.00	.70	.00	.85
Education	r	.07	1.00	.17	.08	.13	.17	.03	.09	-.02	.03	.27	.07	.01	-.07	-.10	-.14	-.11	.21	.36	.20	-.04	.20	-.04
	p	.27	.	.01	.27	.05	.01	.65	.20	.77	.66	.00	.27	.93	.29	.12	.04	.11	.00	.00	.00	.53	.00	.56
Physical Functioning	r	-.35	.17	1.00	.49	.46	.47	.59	.29	.27	.26	.17	.21	.10	-.10	.01	.16	.22	.17	.12	.85	.06	.80	.15
	p	.00	.01	.	.00	.00	.00	.00	.00	.00	.00	.01	.00	.13	.15	.87	.02	.00	.01	.07	.00	.37	.00	.03
Role Physical	r	-.06	.08	.49	1.00	.47	.46	.49	.53	.52	.45	.04	.15	.03	-.14	.05	.16	.12	.04	.07	.71	.41	.73	.44
	p	.37	.27	.00	.	.00	.00	.00	.00	.00	.00	.56	.03	.69	.04	.44	.02	.08	.55	.30	.00	.00	.00	.00
Bodily Pain	r	-.07	.13	.46	.47	1.00	.49	.53	.47	.35	.42	.05	.05	.05	-.19	.04	.17	.12	-.04	.03	.71	.33	.66	.38
	p	.29	.05	.00	.00	.	.00	.00	.00	.00	.00	.47	.50	.47	.00	.56	.01	.07	.56	.64	.00	.00	.00	.00
General Health	r	-.09	.17	.47	.46	.49	1.00	.60	.37	.28	.42	.17	.11	-.01	-.15	.06	.19	.18	.04	.06	.68	.34	.61	.38
	p	.19	.01	.00	.00	.00	.	.00	.00	.00	.00	.01	.09	.89	.03	.38	.01	.01	.58	.35	.00	.00	.00	.00
Vitality	r	-.35	.03	.59	.49	.53	.60	1.00	.36	.32	.48	.17	.21	.04	-.11	.16	.28	.19	.01	-.03	.67	.46	.63	.47
	p	.00	.65	.00	.00	.00	.00	.	.00	.00	.00	.01	.00	.53	.12	.02	.00	.00	.85	.71	.00	.00	.00	.00
Social Functioning	r	.03	.09	.29	.53	.47	.37	.36	1.00	.51	.51	.09	.09	-.02	-.12	-.04	.08	.06	-.07	.05	.40	.69	.42	.64
	p	.61	.20	.00	.00	.00	.00	.00	.	.00	.00	.20	.19	.83	.08	.57	.26	.35	.30	.47	.00	.00	.00	.00
Role Emotional	r	.03	-.02	.27	.52	.35	.28	.32	.51	1.00	.52	.06	.11	-.05	-.18	.02	.11	.07	.05	.02	.25	.77	.27	.77
	p	.68	.77	.00	.00	.00	.00	.00	.00	.	.00	.38	.10	.47	.01	.71	.12	.33	.44	.72	.00	.00	.00	.00
Mental Health	r	-.06	.03	.26	.45	.42	.42	.48	.51	.52	1.00	.09	.06	-.05	-.25	.10	.18	.19	.05	.07	.27	.83	.32	.81
	p	.40	.66	.00	.00	.00	.00	.00	.00	.00	.	.17	.38	.45	.00	.14	.01	.00	.48	.32	.00	.00	.00	.00
Cognition	r	-.14	.27	.17	.04	.05	.17	.17	.09	.06	.09	1.00	.42	.04	-.07	.03	.02	.12	.26	.21	.13	.08	.08	.12
	p	.05	.00	.01	.56	.47	.01	.01	.20	.38	.17	.	.00	.52	.32	.62	.75	.09	.00	.00	.06	.22	.23	.08
Memory Performance	r	-.33	.07	.21	.15	.05	.11	.21	.09	.11	.06	.42	1.00	-.12	-.15	.10	.18	.06	.10	.08	.17	.07	.21	.07
	p	.00	.27	.00	.03	.50	.09	.00	.19	.10	.38	.00	.	.09	.03	.15	.01	.36	.13	.27	.01	.28	.00	.29

Table 4.2 (continued).

		Age	Education Physical Functioning	Role Physical	Bodily Pain General Health	Vitality Social Functioning	Role Emotional Mental Health	Cognition Memory Performance	Achievement	Anxiety	Capacity	Change	Locus	Strategy	Task	PCS36	MCS36	PCS12	MCS12					
Achievement	r	.06	.01	.10	.03	.05	-.01	.04	-.02	-.05	-.05	.04	-.12	1.00	.25	.10	-.06	.34	.25	.16	.09	-.08	.06	-.03
	p	.34	.93	.13	.69	.47	.89	.53	.83	.47	.45	.52	.09	.	.00	.16	.38	.00	.00	.02	.17	.22	.38	.62
Anxiety	r	.15	-.07	-.10	-.14	-.19	-.15	-.11	-.12	-.18	-.25	-.07	-.15	.25	1.00	-.34	-.43	-.25	.23	-.04	-.12	-.20	-.13	-.20
	p	.03	.29	.15	.04	.00	.03	.12	.08	.01	.00	.32	.03	.00	.	.00	.00	.00	.00	.61	.07	.00	.06	.00
Capacity	r	-.19	-.10	.01	.05	.04	.06	.16	-.04	.02	.10	.03	.10	.10	-.34	1.00	.66	.33	-.19	-.06	.03	.08	.05	.11
	p	.01	.12	.87	.44	.56	.38	.02	.57	.71	.14	.62	.15	.16	.00	.	.00	.00	.01	.41	.61	.26	.45	.11
Change	r	-.25	-.14	.16	.16	.17	.19	.28	.08	.11	.18	.02	.18	-.06	-.43	.66	1.00	.41	-.22	-.21	.19	.15	.17	.16
	p	.00	.04	.02	.02	.01	.01	.00	.26	.12	.01	.75	.01	.38	.00	.00	.	.00	.00	.00	.00	.03	.01	.02
Locus	r	-.19	-.11	.22	.12	.12	.18	.19	.06	.07	.19	.12	.06	.34	-.25	.33	.41	1.00	.13	.05	.19	.10	.16	.13
	p	.00	.11	.00	.08	.07	.01	.00	.35	.33	.00	.09	.36	.00	.00	.00	.00	.	.06	.46	.00	.15	.02	.05
Strategy	r	-.02	.21	.17	.04	-.04	.04	.01	-.07	.05	.05	.26	.10	.25	.23	-.19	-.22	.13	1.00	.30	.08	-.03	.03	.03
	p	.82	.00	.01	.55	.56	.58	.85	.30	.44	.48	.00	.13	.00	.00	.01	.00	.06	.	.00	.26	.67	.62	.67
Task	r	.06	.36	.12	.07	.03	.06	-.03	.05	.02	.07	.21	.08	.16	-.04	-.06	-.21	.05	.30	1.00	.09	.00	.10	.04
	p	.41	.00	.07	.30	.64	.35	.71	.47	.72	.32	.00	.27	.02	.61	.41	.00	.46	.00	.	.16	.97	.13	.59
PCS36	r	-.24	.20	.85	.71	.71	.68	.67	.40	.25	.27	.13	.17	.09	-.12	.03	.19	.19	.08	.09	1.00	.09	.93	.18
	p	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.06	.01	.17	.07	.61	.00	.00	.26	.16	.	.17	.00	.01
MCS36	r	.03	-.04	.06	.41	.33	.34	.46	.69	.77	.83	.08	.07	-.08	-.20	.08	.15	.10	-.03	.00	.09	1.00	.15	.94
	p	.70	.53	.37	.00	.00	.00	.00	.00	.00	.00	.22	.28	.22	.00	.26	.03	.15	.67	.97	.17	.	.03	.00
PCS12	r	-.23	.20	.80	.73	.66	.61	.63	.42	.27	.32	.08	.21	.06	-.13	.05	.17	.16	.03	.10	.93	.15	1.00	.18
	p	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.23	.00	.38	.06	.45	.01	.02	.62	.13	.00	.03	.	.01
MCS12	r	.01	-.04	.15	.44	.38	.38	.47	.64	.77	.81	.12	.07	-.03	-.20	.11	.16	.13	.03	.04	.18	.94	.18	1.00
	p	.85	.56	.03	.00	.00	.00	.00	.00	.00	.00	.08	.29	.62	.00	.11	.02	.05	.67	.59	.01	.00	.01	.

Note. A total of 217 subjects were available for all correlation analyses. PCS36 = physical component summary measure from SF-36; MCS36 = mental component summary measure from SF-36; PCS12 = physical component summary measure from SF-12; MCS12 = mental component summary measure from SF-12.

RESEARCH QUESTION 1

What is the range of health status, cognition, memory performance, and metamemory in the elderly, aged 65 or older? This question was addressed with mean, standard deviation, range, and population norm where available. Whenever a population norm was available, it was presented and compared with a corresponding sample mean. Also t-tests were conducted to see whether there was any significant difference of scores on those variables between females and males, between Caucasians and African-Americans, and between the two age groups of older adults.

Health Status

Health status was measured with the Medical Outcomes Study Short Form 36-item Health Survey (SF-36) and the Medical Outcomes Study Short Form 12-item Health Survey (SF-12). With SF-36 data, it is possible to compute either eight subscale scores or two summary measure scores. The eight health subscales are Physical Functioning, Role Physical, Bodily Pain, General Health, Vitality, Social Functioning, Role Emotional, and Mental Health. The two summary measures from SF-36 are the physical component summary measure (PCS36) and the mental component summary measure (MCS36). With SF-12 data, it is not possible to compute eight health profile scores, but possible to compute two summary measure scores. The two summary measures from SF-12 are the physical component summary measure (PCS12) and the mental component

summary measure (MCS12). Table 4.3 lists the mean, standard deviation, and range of scores.

Table 4.3: Health Status of Sample.

Health Status	<u>N</u>	<u>M</u>	<u>SD</u>	Range		
Physical Functioning	230	55.87	30.72	0.00	-	100.00
Role Physical	231	61.47	40.69	0.00	-	100.00
Bodily Pain	231	69.38	27.00	0.00	-	100.00
General Health	231	59.37	21.04	5.00	-	100.00
Vitality	231	55.45	23.95	0.00	-	100.00
Social Functioning	231	81.82	26.37	0.00	-	100.00
Role Emotional	229	81.08	33.78	0.00	-	100.00
Mental Health	231	79.79	17.67	16.00	-	100.00
PCS36	228	39.59	11.16	11.02	-	59.74
MCS36	228	54.49	9.60	20.78	-	72.11
PCS12	228	41.13	10.46	16.07	-	56.82
MCS12	228	53.28	9.23	21.48	-	69.89

Note. The higher the score, the better the health status. The range of potential scores for each of the eight health profiles is between 0 and 100. Summary measure scores were adjusted to have a mean of 50 and a standard deviation of 10, using norms taken from the general U.S. population. PCS36 = physical component summary measure from SF-36; MCS36 = mental component summary measure from SF-36; PCS12 = physical component summary measure from SF-12; MCS12 = mental component summary measure from SF-12.

The mean of each scale score was compared using t-tests between females and males, between Caucasians and African-Americans, and between the two age groups of older adults, to see whether differences between groups were statistically significant (see Table 4.4). When the health status was compared between females and males, males had significantly higher scores on the scales of Physical Functioning and Bodily Pain (both $p < .01$), and Vitality and Social Functioning (both $p < .05$). Therefore, males scored significantly higher on PCS36 ($p < .01$) and PCS12 ($p < .05$), since the health concept of Physical Functioning contributes the largest portion of the scores in PCS36 and PCS12, and the health concept of Bodily Pain contributes the third largest proportion of the scores in PCS36 and PCS12. One interesting fact to be noted here is that the difference of health status between females and males seemed to be captured more strongly with PCS36 than with PCS12, by observing the magnitude of p values. The p values, however, do not imply the magnitude of practical meaningfulness in both tests (Slakter, Wu, & Suzuki-Slakter, 1991; Smith, 1983). Effect sizes of Cohen's d (Cohen, 1977) supported this argument. The effect size d was .44 for PCS36 and .36 for PCS12. Generally, effect sizes d ranging from .33 to .55 are considered to have medium effects (Lipsey, 1990, p. 56).

In comparing health status between two racial groups, Caucasians showed higher scores than African-Americans on the scales of Physical Functioning and Role Emotional (both $p < .05$). But none of differences of summary measure scores between two racial groups was statistically significant at the .05 level.

In comparing health status between two age groups of adults, adults in the 65 to 74 age group showed better health status than the rest for the two health concepts of Physical Functioning and Vitality (both $p < .01$). Statistically significant differences also were found between the two age groups for PCS36 and PCS12. Again, as was the case with gender comparisons, comparing health status between the two age groups seemed to be more clearly captured with PCS36 ($p < .01$) than PCS12 ($p < .05$), by observing the magnitude of p values. However, small p value do not imply large effect (Slakter, Wu, & Suzuki-Slakter, 1991; Smith, 1983). The effect size d between the two age groups was .40 for PCS36, and .33 for PCS12. These are considered medium effects (Lipsey, 1990, p. 56).

It should be remembered that, since multiple analyses were conducted on the same sample, any significant difference between groups may be the result of chance alone. In other words, any significant difference found in the sample might actually have come from a population where no difference exists. This does not mean that all significant results from multiple t -tests with the study sample were meaningless. Instead, it should be reminded that, in one out of 20 tests, the null hypothesis could mistakenly be rejected when the null hypothesis is in fact true.

Table 4.4: Comparisons of Health Status between Gender, Race, and Age Groups.

	Female ($n = 159$)		Male ($n = 69$)		p^a
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	
Physical Functioning	51.54	(30.43)	65.87	(29.37)	.001
Role Physical	59.12	(41.85)	67.39	(37.70)	<u>ns</u>
Bodily Pain	65.73	(27.58)	78.88	(23.34)	.001
General Health	58.53	(21.34)	61.42	(20.71)	<u>ns</u>
Vitality	52.83	(24.08)	61.38	(22.83)	.013
Social Functioning	79.87	(28.47)	86.78	(20.66)	.041
Role Emotional	79.87	(34.98)	85.02	(29.45)	<u>ns</u>
Mental Health	78.57	(18.40)	83.13	(15.01)	<u>ns</u>
PCS36	38.12	(11.23)	42.99	(10.27)	.002
MCS36	54.07	(10.27)	54.07	(7.82)	<u>ns</u>
PCS12	39.99	(10.49)	43.77	(9.96)	.012
MCS12	52.63	(9.98)	54.79	(7.01)	<u>ns</u>
	Caucasian ($n = 113$)		African-American ($n = 95$)		p^a
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	
Physical Functioning	62.03	(30.49)	53.21	(29.07)	.035
Role Physical	64.38	(40.48)	60.79	(41.36)	<u>ns</u>
Bodily Pain	72.38	(25.49)	67.79	(27.07)	<u>ns</u>
General Health	61.63	(22.15)	58.31	(20.68)	<u>ns</u>
Vitality	56.15	(22.26)	58.00	(24.15)	<u>ns</u>
Social Functioning	84.40	(25.53)	80.00	(26.70)	<u>ns</u>
Role Emotional	87.02	(29.36)	77.54	(35.21)	.039
Mental Health	81.73	(15.87)	79.12	(18.12)	<u>ns</u>

Table 4.4 (continued).

	Caucasian ($n = 113$)		African-American ($n = 95$)		p^a
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	
PCS36	41.11	(11.49)	38.99	(10.65)	<u>ns</u>
MCS36	55.24	(8.57)	54.20	(10.55)	<u>ns</u>
PCS12	42.28	(10.72)	40.58	(9.83)	<u>ns</u>
MCS12	54.56	(7.92)	52.80	(9.80)	<u>ns</u>
	65 to 74 ($n = 85$)		75 or older ($n = 143$)		p^a
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	
Physical Functioning	64.85	(28.67)	50.55	(30.82)	.001
Role Physical	63.82	(40.55)	60.31	(40.93)	<u>ns</u>
Bodily Pain	71.88	(24.05)	68.42	(28.63)	<u>ns</u>
General Health	61.94	(20.08)	57.90	(21.68)	<u>ns</u>
Vitality	61.29	(22.16)	51.92	(24.42)	.004
Social Functioning	80.88	(26.97)	82.60	(26.29)	<u>ns</u>
Role Emotional	79.22	(34.88)	82.75	(32.59)	<u>ns</u>
Mental Health	79.53	(18.51)	80.20	(16.99)	<u>ns</u>
PCS36	42.35	(10.32)	37.95	(11.35)	.004
MCS36	53.53	(10.23)	55.06	(9.20)	<u>ns</u>
PCS12	43.29	(9.75)	39.85	(10.69)	.016
MCS12	52.44	(9.64)	53.79	(8.97)	<u>ns</u>

Note. The higher the score, the better the health status. The alpha level was set at .05. ^at-tests were conducted between groups. PCS36 = physical component summary measure from SF-36; MCS36 = mental component summary measure from SF-36; PCS12 = physical component summary measure from SF-12; MCS12 = mental component summary measure from SF-12.

Cognitive Function

Cognition, memory performance, and metamemory were measured to explore the older adults' cognitive function in the current study. The mean, standard deviation, and range of each scale score from the sample were reported in the order of cognition, memory performance, and metamemory. Norms were also reported and compared with sample scores whenever norm values were available.

Cognition

The cognition of the study sample was measured with MMSE. The cognition scores from the sample showed a limited range between 23 and 30 ($N = 231$, $M = 27.39$, $SD = 2.16$), since subjects with cognition scores less than 23 were not eligible to participate in the two primary studies (McDougall, 2001; McDougall, Holston, & Wilke, 2001). Cognition scores below 23 indicate mild cognitive impairment, and, therefore, many cognitive studies screen out subjects with cognitive scores less than 23.

The mean cognition scores were not significantly different between females and males, and between the two age groups, but were different between Caucasians and African-Americans at the .05 level of significance. Caucasians performed better at the cognition test than African-Americans did ($t(207) = -4.799$, $p = .000$) (see Table 4.5). The higher level of cognition scores in Caucasians was expected, given that the education level of Caucasians was significantly higher than that of African-Americans ($p = .000$). Therefore, as an

additional analysis, ANCOVA was conducted using education level as a covariate. The difference between the two adjusted mean cognition scores from the two racial groups was, even though small, still found to be statistically significant after eliminating the effect of education on cognition ($F(1, 205) = 8.72, p = .004$). The adjusted mean cognition score for Caucasians was 27.76, and it was 26.85 in African-Americans. The large sample size included in the ANCOVA may have contributed to making the difference statistically significant.

Table 4.5: Comparisons of Cognition between Gender, Race, and Age Groups.

Characteristics	n	Cognition		p ^a
		<u>M</u>	<u>SD</u>	
Gender				
Female	162	27.25	2.24	<u>ns</u>
Male	69	27.72	1.92	
Race				
Caucasian	114	27.98	1.93	.000
African-American	95	26.61	2.20	
Age				
65-74	86	27.74	2.17	<u>ns</u>
75 or older	145	27.18	2.13	

Note. The alpha level was set at .05. ^at-tests were conducted between groups.

Cognition scores from the subjects in the current study were examined with the corresponding U.S. population norms. A total of 18,056 in five metropolitan areas in the U.S. were included in the analysis of cognition norms (Crum, Anthony, Bassett, & Folstein, 1993). To conform the availability of the population norms, the study sample was divided into several groups based on their ages and educational backgrounds. The distribution of the sample's cognition scores showed similar pattern to the distribution of population scores. Both sample and population scores decreased as subjects were older and less educated (see Table 4.6).

Table 4.6: Cognition Scores of Sample and U.S. Population.

Education ^a	Age ^a									
	65-69		70-74		75-79		80-84		85 or older	
0 - 4										
<u>n</u>	126		139	1	112	1	105		61	
<u>M</u>	22		22	29	21	24	20		19	
<u>SD</u>	1.9		1.7		2.0		2.2		2.9	
Lower	19		19	29	18	24	16		15	
Median	22		21	29	21	24	19		20	
Upper	25		24	29	24	24	23		23	
5 – 8										
<u>n</u>	633		533	6	437	13	241	9	134	8
<u>M</u>	26		26	26.5	25	24.9	25	25.4	23	24.9
<u>SD</u>	1.7		1.8	1.4	2.1	1.6	1.9	1.7	3.3	1.5
Lower	24		24	25.0	22	23.0	22	24.0	21	23.3
Median	27		26	26.5	26	25.0	25	25.0	24	25.0
Upper	29		28	28.0	28	26.0	27	27.0	27	26.0
9 – 12										
<u>n</u>	814	4	550	43	315	31	163	20	99	5
<u>M</u>	28	27.3	27	27.7	27	27.6	25	27.9	26	26.8
<u>SD</u>	1.4	2.8	1.6	2.3	1.5	1.8	2.3	1.7	2.0	1.8
Lower	27	24.5	26	26.0	25	27.0	23	27.0	23	25.0
Median	28	27.5	28	28.0	27	28.0	26	28.0	26	28.0
Upper	29	29.8	29	30.0	29	29.0	28	29.0	28	28.0

Table 4.6 (continued).

Education ^a	Age ^a									
	65-69		70-74		75-79		80-84		85 or older	
13 or more										
<u>n</u>	358	5	255	26	181	23	96	12	52	23
<u>M</u>	29	29.2	28	27.9	28	28.1	27	28.3	27	27.5
<u>SD</u>	1.0	0.8	1.6	2.1	1.6	2.3	0.9	1.7	1.3	1.8
Lower	28	28.5	27	26.8	27	26.0	26	27.3	25	26.0
Median	29	29.2	29	28.0	28	29.0	28	29.0	28	27.0
Upper	30	30.0	29	30.0	29	30.0	29	29.8	29	29.0
Total										
<u>n</u>	1931	9	1477	76	1045	68	605	41	346	36
<u>M</u>	27	28.3	27	27.7	26	27.2	25	27.5	24	26.8
<u>SD</u>	1.6	2.1	1.8	2.2	2.1	2.3	2.2	2.0	2.9	2.0
Lower	26	27.0	24	26.0	23	25.0	21	26.5	21	25.3
Median	28	29.0	27	28.0	26	27.5	25	28.0	25	27.0
Upper	29	30.0	29	30.0	28	29.0	28	29.0	28	28.0

Note. Cognition scores presented in shaded area came from the general U.S. population, and covered the whole range of potential scores. Cognition scores presented in clear area came from the study sample, and were available in limited range of 23 to 30. Lower = lower quartile; Upper = upper quartile.

^a Age and Education were measured in years.

Memory Performance

The study participants' memory performance was measured with RBMT. The sample's memory performance scores ranged from 2 to 24 ($N = 230$, $M = 16.94$, $SD = 4.21$), and the scores showed a negatively skewed distribution (see Figure 4.1). The range and distribution of the sample's scores are in accordance with the distribution of memory performance scores reported in the literature (Cockburn & Smith, 1989, 1991). The memory performance scores from a total of 44 men and 75 women, with a mean age of 80.49 ($SD = 5.22$, Range = 70 - 94) and with a mean education level of 9.51 years ($SD = 1.66$, Range = 6 - 17), covered the entire range of potential scores, and were negatively skewed with a mean of 15.54 ($SD = 2.93$) (Cockburn & Smith, 1989). From a total of 94 community-dwelling people with age range from 70 to 93 years, memory performance scores measured with RBMT ranged from 3 to 24, and averaged into 16.30 ($SD = 5.2$) (Cockburn & Smith, 1991).

The sample's mean score of memory performance was compared between gender, race, and age groups (see Table 4.7). While memory performance scores were not significantly different between females and males, and between Caucasians and African-Americans, the scores were significantly different between the two age groups of older adults. The older adults aged 65 to 74 performed better at everyday memory tasks than the older adults aged 75 or older did ($t(228) = 3.007$, $p = .003$), with the effect size d of .41.

Figure 4.1: Distribution of Sample's Memory Performance Scores.

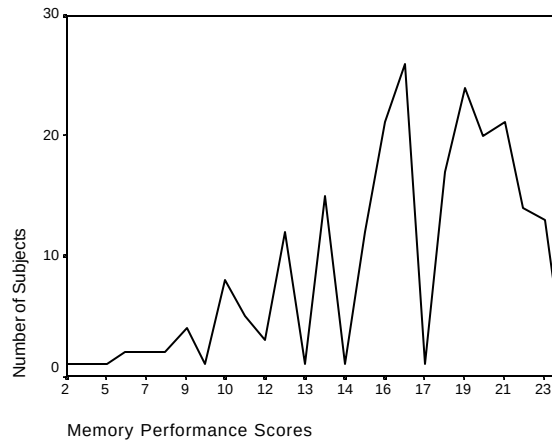


Table 4.7: Comparisons of Memory Performance between Gender, Race, and Age Groups.

Characteristics	<u>n</u>	<u>Memory Performance</u>		<u>p</u> ^a
		<u>M</u>	<u>SD</u>	
Gender				
Female	161	16.68	4.37	<u>ns</u>
Male	68	17.55	3.79	
Race				
Caucasian	113	16.69	4.10	<u>ns</u>
African-American	94	17.32	4.33	
Age				
65-74	86	18.00	4.04	.003
75 or older	144	16.31	4.20	

Note. The alpha level was set at .05. ^at-tests were conducted between groups.

Metamemory

Metamemory was measured with the seven subscales in MIA. Table 4.8 lists the means, standard deviations, and ranges of scores on the seven metamemory variables from the current study sample. The higher the score on the seven metamemory variables, the better an individual would understand memory functioning and would perform in everyday memory tasks. Subjects in the current study showed the highest mean score on the variable of Task which is the level of understanding of general memory processes. The next highest mean score was on the variable of Achievement which is the subjects' perception of how important it is to have good memory, and to perform well on memory tasks. The lowest mean score was found on Change. The higher the score on Change, the less an individual believes that memory is subject to change. This pattern is similar to what is reported in the literature (Ponds & Jolles, 1996). When a total of 50 older adults with a mean age of 63.1 ($SD = 8.7$) completed MIA, the two highest mean scores were on the variables of Achievement ($M = 4.14$) and Task ($M = 4.05$), and the lowest score was on Change ($M = 2.13$). The mean scores from the 50 older adults on other metamemory variables were 3.55 for Anxiety, 2.56 for Capacity, 3.17 for Locus, and 3.78 for Strategy.

Table 4.8: Metamemory of Sample.

Metamemory	Items	<u>n</u>	<u>M</u>	<u>SD</u>	Range
Achievement	16	220	3.75	.38	2.63 – 4.75
Anxiety	14	231	3.13	.56	1.36 – 4.71
Capacity	17	231	3.09	.54	1.53 – 4.76
Change	18	231	2.57	.58	1.06 – 4.33
Locus	9	231	3.43	.52	1.89 – 4.78
Strategy	18	231	3.35	.60	1.78 – 4.72
Task	16	220	3.81	.33	2.88 – 4.81

Note. Potential mean scores in each scale range from 1 to 5.

The sample's mean scores on the seven metamemory variables were compared between gender, race, and age groups (see Table 4.9). Between females and males, there was no significant difference in mean scores on the seven metamemory variables. When mean scores on the seven metamemory variables were compared between Caucasians and African-Americans, significant differences were found on Strategy and Task ($p < .000$ in both), with the effect size d of .52 and .72 respectively. When mean scores on the seven metamemory variables were compared between the two age groups, the metamemory variable of Change was significantly different between groups ($p < .05$), with the effect size d of .35.

Table 4.9: Comparisons of Metamemory Variables between Gender, Race, and Age Groups.

	Female (<u>n</u> = 152)		Male (<u>n</u> = 68)		<u>p</u> ^a
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	
Achievement	3.77	(.38)	3.71	(.38)	<u>ns</u>
Anxiety	3.17	(.55)	3.03	(.59)	<u>ns</u>
Capacity	3.10	(.48)	3.02	(.62)	<u>ns</u>
Change	2.55	(.54)	2.58	(.64)	<u>ns</u>
Locus	3.44	(.51)	3.42	(.52)	<u>ns</u>
Strategy	3.41	(.62)	3.32	(.53)	<u>ns</u>
Task	3.80	(.35)	3.83	(.29)	<u>ns</u>

	Caucasian (<u>n</u> = 108)		African-American (<u>n</u> = 90)		<u>p</u> ^a
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	
Achievement	3.75	(.39)	3.75	(.33)	<u>ns</u>
Anxiety	3.06	(.56)	3.19	(.56)	<u>ns</u>
Capacity	3.08	(.55)	3.11	(.49)	<u>ns</u>
Change	2.58	(.59)	2.59	(.56)	<u>ns</u>
Locus	3.44	(.55)	3.47	(.46)	<u>ns</u>
Strategy	3.51	(.54)	3.21	(.61)	.000
Task	3.90	(.31)	3.68	(.30)	.000

Table 4.9 (continued).

	65 to 74 (<u>n</u> = 80)		75 or older (<u>n</u> = 140)		<u>p</u> ^a
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	
Achievement	3.72	(.39)	3.76	(.37)	<u>ns</u>
Anxiety	3.04	(.61)	3.17	.54)	<u>ns</u>
Capacity	3.14	(.54)	3.04	.53)	<u>ns</u>
Change	2.69	(.54)	2.49	(.58)	.010
Locus	3.50	(.50)	3.39	(.52)	<u>ns</u>
Strategy	3.33	(.57)	3.41	(.60)	<u>ns</u>
Task	3.77	(.29)	3.84	(.35)	<u>ns</u>

Note. The alpha level was set at .05. ^at-tests were conducted between groups.

In sum, for the first research question, the study participants' health status, cognition, memory performance, and metamemory were explored. The first finding was that the patterns of describing differences and similarities of health status between gender, race, and age groups in the sample were similar for the 36-item summary measures and 12-item summary measures. The second finding was about exploring cognitive function in the elderly and about comparing cognitive function scores between groups. Scores on none of the cognitive function variables were different between females and males. This is interesting, given that males were more educated than females. Between the two racial groups, Caucasians scored higher on Cognition, Strategy, and Task. Between the two age

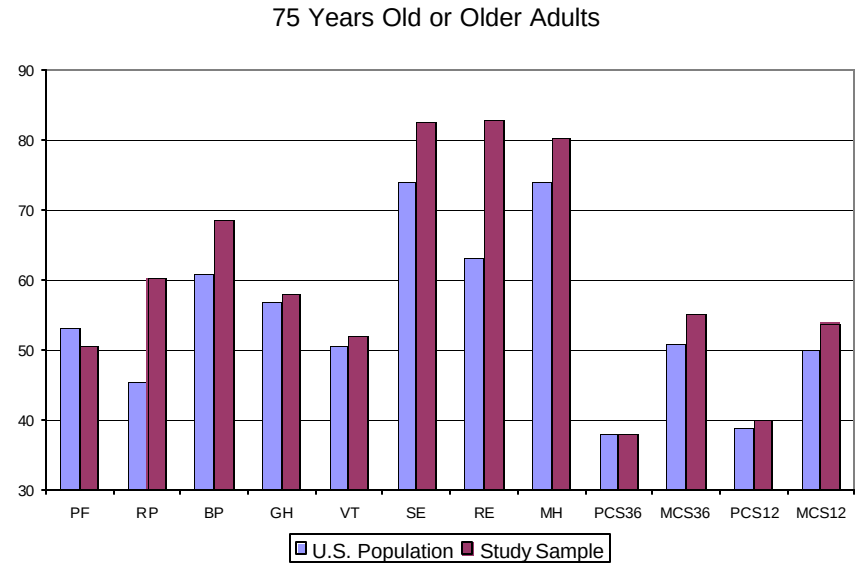
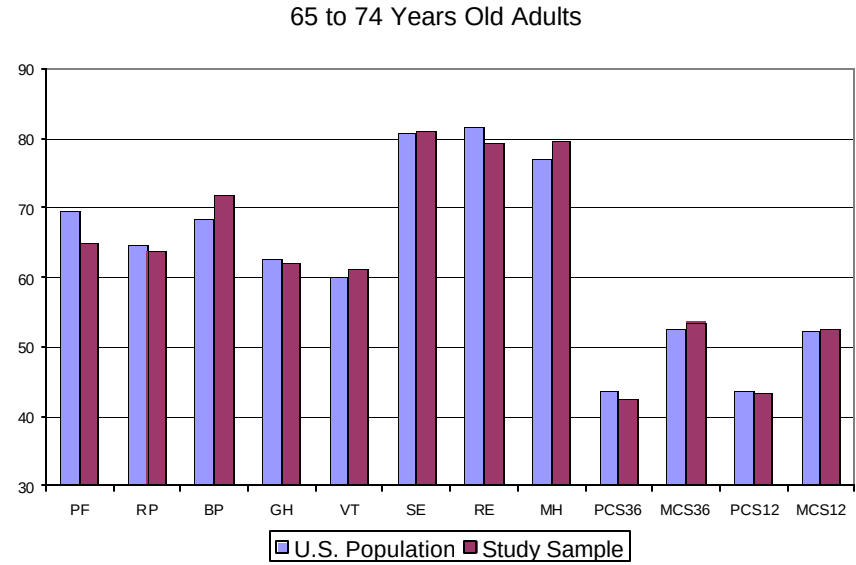
groups, older adults aged 75 or older scored higher on Change, while older adults aged between 65 to 74 performed better at everyday memory performance tasks.

RESEARCH QUESTION 2

Does health status vary as a function of measures, when health status in the elderly is assessed with the SF-36 and SF-12? Scores on summary measures from the two health status measures of SF-36 and SF-12 were compared to the norms from the general U.S. population in 1990 (Ware, Snow, Kosinski, & Gandek, 1993; Ware, Kosinski, & Keller, 1994). To be able to compare the health status of the current sample to the corresponding norms, the current study sample was divided into two groups based on their ages, since the general U.S. population norms were reported separately for two age groups. One group included older adults aged 65 to 74 year-old ($n = 86$, 37.2 %), and the other included older adults aged 75 or older ($n = 145$, 62.8 %). Then scores on various health status variables were computed for each age group of the sample, and compared to the corresponding population norms.

First, scores on various health status variables from the study sample in two age groups were examined with the corresponding population scores by bar graph analysis separately for each age group (see Figure 4.2). The graphs revealed inconclusive differences between the sample and the general U.S. population on various health status variables. It was also noted that the health status of older adults aged 75 or older showed greater discrepancies from the norms than that of older adults aged 65 to 74.

Figure 4.2: Comparisons of Health Status between Sample and U.S. Population.



The scores on health status variables from both the study sample and the general U.S. population were compared employing 95 percent confidence intervals first, and then employing *t*-tests whenever needed. If a 95 percent confidence interval of a sample's mean score on a health status variable did not include the corresponding norm from the general U.S. population, it was concluded that the sample mean was significantly different from the population mean at .05 significance level. When a significant difference at the .05 level was found between sample and population means, a further analysis using *t*-test was conducted.

The comparisons using 95 percent confidence intervals and *t*-tests were first made with scores from the older adults aged 65 to 74 (see Table 4.10). When 95 confidence intervals of sample's mean scores on health status variables were examined with the corresponding U.S. population norms, all health status norms from the population were included in the corresponding 95 percent confidence intervals. This meant that the sample's mean scores on various health variables, including eight health concepts, two summary measures from SF-36, and two summary measures from SF-12, were not significantly different from the corresponding norms. In other words, the health status of older adults aged 65 to 74 in the sample was not significantly different from that of age-matched, general U.S. population at the .05 alpha level. Therefore, any further analysis using a *t*-test was not conducted with any of health status variables.

Table 4.10: Comparisons of Health Status between Sample and U.S. Population: Older Adults aged between 65 and 74 only ^a.

	U.S.	Older adults aged between 65 to 74		
	Population	95% Confidence Interval		
	<u>M</u>	<u>M</u>	Lower	Upper
Physical Functioning	69.38	64.85	58.67	71.03
Role Physical	64.54	63.82	55.08	72.57
Bodily Pain	68.49	71.88	66.69	77.07
General Health	62.56	61.94	57.61	66.27
Vitality	59.94	61.29	56.51	66.07
Social Functioning	80.61	80.88	75.06	86.70
Role Emotional	81.44	79.22	71.69	86.74
Mental Health	76.87	79.53	75.54	83.52
PCS36	43.49	42.35	40.13	44.58
MCS36	52.59	53.53	51.33	55.74
PCS12	43.65	43.29	41.19	45.40
MCS12	52.10	52.44	50.36	54.52

Note. The higher the score, the better the health status. PCS36 = physical component summary measure from SF-36; MCS36 = mental component summary measure from SF-36; PCS12 = physical component summary measure from SF-12; MCS12 = mental component summary measure from SF-12.

^a n in the U.S. population = 408; n in the study sample = 86.

However, the health status of older adults aged 75 or older was significantly different from that of age-matched, general U.S. population in some aspects of health status (see Table 4.11). The mean score of Bodily Pain from the study participants aged 75 or older was significantly higher than the population's mean score ($p < .01$). Also in the same age group, the sample's mean scores on Role Physical, Social Functioning, Role Emotional, and Mental Health were significantly higher than the corresponding norms at the alpha level of .001. Mean scores on the three health profile concepts including Physical Functioning, General Health, and Vitality were not significantly different from the general U.S. population norms.

The mean scores on PCS36 and PCS12 in the elderly aged 75 or older in the current study were not significantly different from the corresponding norms, but the sample mean scores on MCS36 and MCS12 were ($p < .001$). This was expected by observing the results of comparisons between sample and population mean scores on eight health variables, since scores on the mental component summary measures are most strongly affected by Mental Health, followed by Role Emotional, Social Functioning, and Vitality.

Table 4.11: Comparisons of Health Status between Sample and U.S. Population: Older Adults aged 75 or older only ^a.

	U.S.	Older adults aged 75 or older		
	Population	95% Confidence Interval		
	<u>M</u>	<u>M</u>	Lower	Upper
Physical Functioning	53.20	50.55	45.45	55.64
Role Physical	45.28	60.31***	53.55	67.08
Bodily Pain	60.88	68.42**	63.69	73.15
General Health	56.66	57.90	54.32	61.49
Vitality	50.41	51.92	47.89	55.96
Social Functioning	73.89	82.60***	78.26	86.95
Role Emotional	63.18	82.75***	77.36	88.14
Mental Health	73.99	80.20***	77.39	83.00
PCS36	38.04	37.95	36.07	39.83
MCS36	50.75	55.06***	53.54	56.58
PCS12	38.68	39.85	38.08	41.62
MCS12	50.06	53.79***	52.30	55.27

Note. The higher the score, the better the health status. PCS36 = physical component summary measure from SF-36; MCS36 = mental component summary measure from SF-36; PCS12 = physical component summary measure from SF-12; MCS12 = mental component summary measure from SF-12.

^a n in the U.S. population = 217; n in the study sample = 145.

* $p < .05$, two-tailed. ** $p < .01$, two-tailed. *** $p < .001$, two-tailed.

Generally speaking, the entire sample's perception of the physical component of health was at the same level as the age-matched U.S. population's perception. As for the mental component of health, while older adults aged between 65 to 74 evaluated it at the same level as the age-matched U.S. population, older adults aged 75 or older evaluated their mental component of health better than that of the population. In conclusion, there was no difference between SF-12 and SF-36 when comparing the health status of the sample to that of the U.S. population.

RESEARCH QUESTION 3

What are the relationships between health status and cognitive function such as cognition, memory performance, and metamemory in the community living elderly, aged 65 or older? To explore the relationships, correlations were assessed using the Pearson product-moment correlational method. Since SF-12 does not provide eight health subscales, only scores of summary measures from both SF-36 and SF-12 were included in the correlation analyses. Before computing correlation coefficients between variables, scatterplots between each pair of study variables were examined to check the linearity of the relationship, and to see whether any outliers existed. Scatterplots revealed no outliers, and showed dots forming roughly round shapes which imply relatively low to moderate correlations (see Table 4.12). Correlation coefficients ranged from $-.20$ ($p < .01$), found between MCS36 and Anxiety, to $.21$ ($p < .01$), found between PCS12 and memory performance.

There was no consistency between the two sets of correlation coefficients; one set of correlations between 36-item summary measures and cognitive function variables vs. the other set of correlations between 12-item summary measures and cognitive function variables. Some of the cognitive function variables were correlated higher with 36-item summary measures than with 12-item summary measures, and vice versa.

Table 4.12: Correlations between Summary Measures and Cognitive Function Variables.

	PCS36	PCS12	MCS36	MCS12
Cognition	.130	.081	.084	.120
Memory Performance	.174*	.205**	.074	.072
Achievement	.093	.059	-.084	-.033
Anxiety	-.122	-.127	-.203**	-.197**
Capacity	.034	.052	.077	.108
Change	.193**	.167*	.146*	.156*
Locus	.190**	.163*	.097	.132
Strategy	.077	.034	-.029	.029
Task	.095	.104	-.002	.036

Note. A total of 217 subjects were available for the correlation analyses. PCS36 = physical component summary measure from SF-36; MCS36 = mental component summary measure from SF-36; PCS12 = physical component summary measure from SF-12; MCS12 = mental component summary measure from SF-12.

* $p < .05$, two-tailed. ** $p < .01$, two-tailed.

The biggest difference between two sets of correlation coefficients - one set of correlations of PCS36 with cognitive function variables and the other set of correlations of PCS12 with cognitive function variables - was .049 which was found between the correlation of PCS36 with Cognition ($r = .130$) and the correlation of PCS12 with Cognition ($r = .081$). As for the mental component summary measures (MCS36 & MCS12), the biggest difference was .058 which was found between the correlation of MCS36 with Strategy ($r = -.029$) and the correlation of MCS12 with Strategy ($r = .029$). However, it is unknown at this point whether these differences in pairs of correlation coefficients are statistically significant.

Statistical analyses were to be conducted to test the hypothesis of no difference between pairs of correlation coefficients, while addressing the research question four and the research question five. The testing, however, was to be conducted only with pairs of correlations that were significantly different from zero at the .05 level. Correlations included in the analyses to address the two research questions are physical summary measures with Memory Performance, Change, and Locus, and mental summary measures with Anxiety and Change.

Before doing so, since correlations of summary measures from both SF-36 and SF-12 with cognitive function variables were not robust, an additional question was asked to examine whether summary measures from both SF-36 and SF-12 were correlated with cognitive function variables as much as the eight health profile variables were with cognitive function variables. The correlations of eight health variables with cognitive function variables were assessed, and the coefficients were listed along with the coefficients between cognitive function

variables and summary measures (see Table 4.13). At a glance, it was easily recognized that coefficients of any cognitive function variable with the eight health variables varied more widely than did coefficients of the same cognitive function variables with summary measures.

In sum, the third research question evaluated the association between the study participants' health status and cognitive function. Correlations between health status and cognitive function variables, on the whole, suggested that older adults' health status was only weakly associated with cognitive function. In addition, additional analysis suggested that the correlations between the eight health variables and cognitive function variables became smaller when scores on the eight health profile variables were summarized into two summary measure scores and correlated with cognitive function variables.

Table 4.13: Correlations between Health Status and Cognitive Function Variables.

	Physical Functioning	Role Physical	Bodily Pain	General Health	Vitality	Social Functioning	Role Emotional	Mental Health	PCS36	PCS12	MCS36	MCS12
Cognition	.17	.04	.05	.17	.17	.09	.06	.09	.13	.08	.08	.12
Memory	.21	.15	.05	.11	.21	.09	.11	.06	.17	.21	.07	.07
Performance												
Achievement	.10	.03	.05	-.01	.04	-.02	-.05	-.05	.09	.06	-.08	-.03
Anxiety	-.10	-.14	-.19	-.15	-.11	-.12	-.18	-.25	-.12	-.13	-.20	-.20
Capacity	.01	.05	.04	.06	.16	-.04	.02	.10	.03	.05	.08	.11
Change	.16	.16	.17	.19	.28	.08	.11	.18	.19	.17	.15	.16
Locus	.22	.12	.12	.18	.19	.06	.07	.19	.19	.16	.10	.13
Strategy	.17	.04	-.04	.04	.01	-.07	.05	.05	.08	.03	-.03	.03
Task	.12	.07	.03	.06	-.03	.05	.02	.07	.09	.10	.00	.04

Note. A total of 217 subjects were available for all correlation analyses. Correlation coefficients of .20 or bigger are reported in shared area. PCS36 = physical component summary measure from SF-36; MCS36 = mental component summary measure from SF-36; PCS12 = physical component summary measure from SF-12; MCS12 = mental component summary measure from SF-12.

RESEARCH QUESTION 4

Which health status measure (SF-36 vs. SF-12) predicts cognitive function such as cognition, memory performance, and metamemory in the elderly, aged 65 or older? To test the hypothesis of no difference in a pair of correlation coefficients a formula given by McNemar (1969, p. 158) was used (see Figure 4.3) to compute a t-value. The t-statistic has t-distribution with N-3 degrees of freedom.

Figure 4.3: Formula Used to Test No Difference between Two Correlation Coefficients.

$$t = \frac{(r_{12} - r_{13})\sqrt{(N - 3)(1 + r_{23})}}{\sqrt{2(1 - r_{12}^2 - r_{13}^2 - r_{23}^2 + 2r_{12}r_{13}r_{23})}}$$

A statistical testing of no difference between a pair of correlation coefficients using the McNemar's formula was conducted only when at least one correlation in a pair was significantly different from zero at the .05 level. The McNemar's t-tests were conducted with only five pairs of correlation coefficients, which were significantly different from zero at the .05 level. The included correlations were Memory Performance, Change, and Locus with physical summary measures, and Anxiety and Change with mental summary measures. Table 4.14 shows pairs of correlation coefficients and McNemar's t-values testing significance of differences between each pair of correlation coefficients. If a McNemar's t-value was greater than 1.960 with a degree of freedom more than

120, the difference between two correlation coefficients was decided to be statistically significant at the .05 significance level. If a t-value is significant at the .05 level, it is concluded that a summary measure from SF-36 explains significantly more or less of variances in a cognitive function variable than the corresponding summary measure from SF-12 would.

Table 4.14: Pairs of Correlations and Significance Testing of the Difference in Each Pair of Correlations.

	r	McNemar's t-value ^a
Memory Performance with PCS36	.174	-1.28
Memory Performance with PCS12	.205	
Change with PCS36	.193	1.07
Change with PCS12	.167	
Locus with PCS36	.190	1.11
Locus with PCS12	.163	
Anxiety with MCS36	-.203	-.26
Anxiety with MCS12	-.197	
Change with MCS36	.146	-.43
Change with MCS12	.156	

Note. A total of 217 subjects were available for all correlation analyses. PCS36 = physical component summary measure from SF-36; MCS36 = mental component summary measure from SF-36; PCS12 = physical component summary measure from SF-12; MCS12 = mental component summary measure from SF-12.

^a t-values were computed using the formula given by McNemar (1969, p. 158).

* $p < .05$, two-tailed. ** $p < .01$, two-tailed. *** $p < .001$, two-tailed.

When the two physical component summary measures were correlated with the three cognitive function variables of Memory Performance, Change, and Locus, none of the correlational differences was found to be statistically significant at the .05 level. When the two mental component summary measures were correlated with the two cognitive function variables of Anxiety and Change, neither correlational differences was found to be statistically significant at the .05 level. In sum, the summary measures from SF-12 were not correlated with cognitive function variables at a significantly lower or higher level than the summary measures from SF-36.

RESEARCH QUESTION 5

The research question five asked, when controlling for age, which health status measure (SF-36 vs. SF-12) predicts cognitive function such as cognition, memory performance, and metamemory in the elderly, aged 65 or older. The same formula (see Figure 4.3) given by McNemar (1969, p. 158), which was introduced to address research question four, was used to answer this research question. However, partial correlation coefficients were used this time, instead of zero-order correlation coefficients.

The theoretical framework of environmental changes claimed that age did not cause the cognitive changes in the elderly, but that age happened to be related to the environmental changes. Instead of age, what affects cognitive changes are all of the changes happening inside and outside of a human, and the cognitive changes are closely related to the health status of the human. Therefore, the fifth research question was posed to investigate whether the same relationships

between health status variables and cognitive function variables would be still present when the age effect was eliminated from the relationships between health status and cognitive function. As an initial step to address research question five, partial correlations were assessed between health status variables and cognitive function variables, after eliminating age effects from the two constructs (see Table 4.15).

Table 4.15: Partial Correlations between Summary Measures and Cognitive Function Variables ^a.

	PCS36	PCS12	MCS36	MCS12
Cognition	.101	.052	.088	.123
Memory Performance	.103	.143	.087	.081
Achievement	.113	.076	-.086	-.034
Anxiety	-.090	-.097	-.209	-.201
Capacity	-.011	.010	.084	.112
Change	.140	.116	.158	.165
Locus	.151	.125	.104	.137
Strategy	.112	.120	-.004	.036
Task	.076	.031	-.028	.029

Note. A total of 217 subjects were available for all correlation analyses. PCS36 = physical component summary measure from SF-36; MCS36 = mental component summary measure from SF-36; PCS12 = physical component summary measure from SF-12; MCS12 = mental component summary measure from SF-12.

* $p < .05$, two-tailed. ** $p < .01$, two-tailed. *** $p < .001$, two-tailed.

However, none of partial correlation coefficients was found to be significantly different from zero at the .05 level (see Table 4.15). This was not a surprise since correlations of age with cognitive function variables were found to be relatively weak, or moderate at best, in the sample, and correlations of health status with cognitive function variables were also weak (see Table 4.2). Therefore, although research question five was a valuable one to ask, a statistical test of no difference between a pair of partial correlation coefficients was not employed at all. In sum, as a result of addressing research question four and five, it was found out that the choice of either SF-36 or SF-12 did not make a practically significant difference in explaining variances in cognitive function variables in this sample of older adults.

SUMMARY

This study was a secondary analysis with a total of 231 participants who met the inclusion criteria for the current study. An individual was eligible if he/she was an older adult who was aged 65 or older, African-American or Caucasian, able to read and speak English as a primary language, and free of cognitive impairments. The purpose of the current study was to investigate the association between health status and cognitive function, and to compare the usefulness of two health measures in explaining variances of cognitive function in the elderly, as well. Five research questions were posed, and various descriptive and inferential statistical analyses were conducted to address the questions.

CHAPTER 5: DISCUSSIONS

This chapter first presents a brief summary of the current study, followed by a discussion of strengths and limitations, as well as implications and recommendations for nursing research, theory, and practice.

SUMMARY OF STUDY

This study is a secondary analysis that was designed to serve two research goals. The first is to investigate the relationship between older adults' perception of health status and their cognitive function. The second is to compare the performance of SF-12 and SF-36 in evaluating older adults' health status and cognitive function.

Study participants were aged 65 years old or older, Caucasians or African-Americans, able to read and speak English as a primary language, and free of cognitive impairment. Data from the eligible participants were extracted from an existing data file. Using the SPSS® 10.0.1 statistical software program, data errors were checked, missing data were managed, and assumptions were checked. Data analyses were conducted with descriptive and inferential statistical methods to address five research questions.

The findings suggest that the 12-item health measures (PCS12 & MCS12) were equivalent to the 36-item health measures (PCS36 & MCS36) in evaluating older adults' health status and cognitive function. In addition, the findings suggest that health status explains a modest amount of variance in the cognitive function of this sample of older adults.

STRENGTHS AND LIMITATIONS

Demographic Characteristics of the Sample

The study participants' demographic characteristics lead to both strengths and weaknesses in the current study. One of strengths in the current study was related to the fact that the study participants were community-living, cognitively intact, and healthy older adults. Conducting race and gender comparisons with this group of older adults on various health and cognitive aspects gave us understandings that could not be often found in other studies with older adults. In addition the number of older adults included in each analysis was larger than the number of subjects included in the analysis of population norms for health status in this group of older adults.

On the other hand, the portion of females and African-Americans among the whole subjects in the current study could be a limitation of the study. Females and African-Americans were over represented in the study as compared to the U.S. population. In this sample, 70 % were females, whereas the U.S. population, aged 65 or older, consisted of only 59 % females (Population Division, U.S. Census Bureau, 2001). Similarly, there were 41.1 % African-Americans, whereas the U.S. population, aged 65 or older, consisted of only 8.2 % African-Americans (Population Division, U.S. Census Bureau, 2003). Given that females and African-Americans tend to be less educated than the rest of the sample, over-representing them in the sample may have skewed some study findings, and resulted in less generalizability of the findings.

The sites and methods used to recruit study participants gave the current study both strengths and limitations too. Subjects were recruited from their own homes (74 %), retirement communities (14 %), and nursing homes (12 %). The heterogeneity of recruitment sites makes the generalizability of study findings broader. In addition, a majority of the subjects living in their own homes were recruited by random methods, thereby strengthening the current study. However, all participants were recruited from one location in northeastern Ohio in the U.S., therefore the results may not be generalizable to older populations of other areas.

Furthermore, other critically important demographic characteristics, such as employment status, which are believed to affect age-related cognitive changes (West, Crook, & Barron, 1992), were not collected. Therefore, the results of this study might well have been different if the data representing these other demographic characteristics had been incorporated into the analyses. This lack of information on these missing demographic characteristics further reduces the generalizability of the study's findings.

Study Design

The primary limitation of the current study was related to the disadvantages of any secondary analysis. One of the disadvantages residing in a secondary analysis is that the researcher of the secondary analysis has no control over the data set, in terms of how the data were collected (Knapp, 1998). The current study analyzed data that was collected by another researcher. Therefore, special efforts were made to show that the three primary studies, as data sources of the current study, were conducted with great care, so as to ensure the quality of

the data. The three primary studies were discussed in detail along with their primary study purposes, funding sources, data collection methods, and participants' demographic characteristics.

The cross-sectional design employed in this study was generally adequate for investigating the psychometric performance of two health measures in relation to cognitive function in the elderly. However, the cross-sectional design did not capture the changes in health status and cognitive function that naturally happen as people age. Although it is not rare to see an individual performing more poorly in terms of cognitive function as the person ages, it has been noted that there are substantial individual differences in cognitive decline (Field, Schaie, & Leino, 1988). Given the fact that each individual shows a substantially different rate of cognitive decline, and, in many cases, no decline at all until very old, the current cross-sectional design which employs a one-time measurement of cognitive function was unable to represent this variability in cognitive changes in the sample. The apparently weak association between health status and cognitive function in this group of older adults may be attributable to the design.

It was interesting to find out that, while 65 to 74 year-old adults perceived their health status to be at the same level as that of the general U.S. population, 75-year old or older adults evaluated their health status, especially their mental component of health, to be better than that of the population. One possible explanation for this may be found from the subjects recruitment process. In the literature, cognitive studies with samples of volunteers have often ended up with subjects who were healthier than expected (Christensen et al., 1994). Since all

participants in the current study were volunteers, individuals who were in good health, especially confident at mental component of health, may have been more likely to participate in the study. In other words, individuals who were having trouble with their mental health, suffering from depression for example, were less likely to participate in any primary studies. As a result, age-related decline in subjectively perceived mental health might well have been underestimated.

Health and Cognition

The variable of cognition was measured with the MMSE. Any interpretation involving cognition must take into consideration the range of cognition scores included in the current study. In the two of primary studies, the instrument of MMSE was employed to screen out individuals with cognitive impairments, which is a standard procedure in cognitive studies. Therefore, this study included only subjects with MMSE scores of 23 or higher. This truncated range of cognition scores could have attenuated correlations of cognition with other variables.

Nevertheless, the findings in relation to cognition did provide us with two important pieces of evidence. The association, even though small, between age and cognition in this sample corroborated findings from other studies. In addition, the association between some of health status aspects and cognition was small but significant. Although significant because of the large sample size, correlations of cognition with other variables were not robust enough to support the author's assumption. The author's assumption was that health status would explain cognitive function in older adults aged 65 or older when the health status was

assessed multidimensionally with multi-item questionnaires. However, it is not clear how the correlations of cognition with other variables such as age or health status variables would be when the cognition scores measured with MMSE were not limited to the certain range.

These associations, however, might not be as small as they appear in the sample if the cognition scores were analyzed along with the study participants' level of education. It is important to remember that cognition scores measured with MMSE are sensitive to education level. Individuals with less than an eighth grade education may score in the abnormal range on the MMSE even though they do not have any cognitive impairment. On the other hand, individuals with more than eight years of education may score within the normal range even when they actually have a cognitive impairment (Crum, Anthony, Bassett, & Folstein, 1993). The older adults in the current study had an average of 12.22 years of education, and only seven percent of the entire sample had less than eight years of education. Therefore, it is likely that the current sample would show less variability of MMSE scores even in the face of some memory impairment.

Health and Memory Performance

Cognitive researchers have often reported that volunteers for cognitive aging studies tend to be highly educated, highly motivated, and, therefore, exhibiting less differences in cognitive function as they age. However, the participants in this study performed more poorly on everyday memory tasks if they were older and less educated, despite the fact that they were all volunteers. This finding may be attributable, in part, to the nature of memory tasks which

were used to assess the participants' memory performance. Like claimed in the purpose of the study in Chapter one, the RBMT consisting of everyday memory tasks which have ecological validity might have been sensitive to capture the cognitive function in older adults.

In addition, analyses of scores on health status and memory performance showed that the older adults' health status was moderately associated with memory performance. When the health status of the current sample was assessed with the eight health scales, two health concepts were found to be significantly associated with memory performance. After weighing and summing scores on these eight health concepts into two summary scores, memory performance was moderately associated with the physical summary measure of PCS36. It could be argued that this finding is limited to this specific sample. This is, however, not likely to be the case. When the scores of health status and memory performance from the study sample were compared to the norms from the general U.S. population, the sample's scores occurred in a range and distribution that was similar to that of the scores of the general population. Therefore, it could be concluded that the current study elucidates the significant underlying associations that exist in older adults, 65 or older, by measuring health status and memory performance which incorporate the measurement issues discussed in the literature.

Health and Metamemory

Metamemory was the subjective measure of cognitive function employed in this study. The correlations between health status aspects and metamemory

aspects were weak when the health status was scored with summary measures such as PCS36, MCS36, PCS12, and MCS12.

Since the correlations were not robust, an additional question was asked to examine whether the seven metamemory variables were correlated with the eight health profile variables in SF-36 as much as with the summary measures. The seven metamemory variables were correlated with the eight health variables in higher magnitudes than with summary measures, although the differences were often small. This is an additional finding that adds to the nursing knowledge base. The finding shows that, rather than summary measures such as PCS36, MCS36, PCS12, or MCS12, the eight subscales in SF-36 do a better job of explaining variances in the seven metamemory variables in some cases.

IMPLICATIONS AND RECOMMENDATIONS

Nursing Research

The two measures of SF-36 and SF-12 were found to be similar in assessing the health status of the community-dwelling elderly aged 65 or older, and in assessing associations between the older adults' health status and cognitive function when the function were assessed using instruments with ecological validity. This is an addition to the knowledge base of nursing, in relation to the psychometric characteristics of SF-36 and SF-12.

Given the fact that these two health measures could interchangeably used with this age group of older adults, practicalities such as time, money, and/or respondent burden, will be the next issue to consider when one of these two measures is selected. The SF-12 would be preferable to the SF-36 for a large scale

study, a study where study participants' health status is measured repeatedly, or a study with participants who are very old and/or who require more time to read and complete questionnaires. In these situations, administering the 36-item questionnaire is more costly, in terms of both time and money, than administering the 12-item questionnaire. However, further studies are needed to determine whether both SF-36 and SF-12 would be sensitive in capturing longitudinal changes of health status in the elderly.

In addition, it would be more appropriate to use the summary measures from either SF-36 or SF-12, instead of the eight health scales, when the chance of making a Type I error is a great concern. In the process of examining the current study participants' health status, multiple analyses using *t*-tests and 95 percent confidence intervals were conducted with the same set of subjects at .05 significance level. Every test had the same Type I error rate, one out of twenty. This was not the case, however, when Type I error rates were added whenever testing each health status variable between groups was repeated. Still, it is important to take the error rate into consideration since too many comparisons were employed on the same set of subjects when the eight health variables and the four summary measures were compared between gender, race, and the two age groups. If summary measures from either SF-36 or SF-12 were used in a study, only two comparisons would be needed, as opposed to eight comparisons if the eight health scales were used. The fewer comparisons conducted, the lower the chances of committing a Type I error.

As suggested by an additional analysis, the eight health scales in SF-36 may be a better choice, however, instead of two summary measures from either SF-36 or SF-12, for cognitive aging studies. The eight health scales were associated with cognitive function variables with greater variance than were the summary measures, especially when the cognitive function was measured with MMSE, RBMT, and/or MIA. However, since the eight subscales are represented differently in each of the summary measures, researchers need to carefully consider what aspects of health are of interest when deciding variables to use between eight subscales or two summary measures.

Health status was associated with cognitive function in this group of older adults, although modest. Since the current study was a correlational study with a cross-sectional design, it is not clear if the association would be found again when the health status was intervened. Future research needs look at whether health promoting interventions can affect, or at least delay, age-related cognitive changes in older adults. However, researchers may not expect to see large changes in the association between health status and cognitive function as they intervene to promote this age group of older adults' health status, at least when health status is measured by these generic measures.

One needs to take into consideration the variability of MMSE scores when the scores are used other than a simple screening purpose. It has been reported that MMSE scores are fairly stable with increasing age. As reported by Crum, Anthony, Bassett, and Folstein (1993), mean MMSE scores were always 23 or more in the elderly, 65 or older, unless older adults had less than five years of

education. When people aged 65 or older were tested with the MMSE, the mean MMSE score was 23 when people had five to eight years of education, 26 when people had nine to twelve years of education, and 27 with thirteen or more years of education. Even the mean MMSE score from a group of very old adults was reported to be high (Holtsberg, Poon, Noble, & Martin, 1995). A group of elderly, 100 years old or older, ($n = 67$), scored a mean MMSE score of 24.79. After excluding some centenarians with visual and literacy deficits, the mean score rose to 25.30. As such, in the literature MMSE scores have been reported to be fairly high and stable, even when the test was administered to a group of very old people.

Nursing Theory

One of the theoretical frameworks supporting the current study is the framework of environmental changes (Salthouse, 1991). The framework claims that the confounding effects between environmental changes and an individual's age-related changes have an impact on the individual's cognitive changes over time. The cognitive changes are heavily influenced by changes in the environment, not only from an individual's changes that tend to accompany aging. However, the framework does not clearly define what factors in the environment specifically affect the cognitive changes, or how to measure them. Instead, the framework lists some examples of changes in the environment which are closely related to people's level of health in general, such as health-related practices, attitudes, social roles, economic opportunities, approaches to the prevention and cure of medical problems, or sensitivity to the importance of

balanced nutrition. Salthouse (1991) asserts that, as a consequence of changes in the environment, people now actually have better health than they enjoyed in the past, generally speaking.

The current study proposed to assess the interactions between environmental changes and older adults' own maturational changes, using two generic measures of health: SF-36 and SF-12. It was hypothesized that an older adult's perception of health is a reflection of overall changes that happen inside and outside of the individual, and the health affects the person's cognitive changes. However, results of the current study did not strongly support the framework of environmental changes. Only weak, or modest at best in some variables, associations were found between health status, assessed with two generic measures, and cognitive function, assessed with three instruments with ecological validity, in this sample of older adults.

In order to account older adults' cognitive function, it was suggested that older adults' health status needs to be conceptualized multidimensionally, and subjectively assessed with multi-item questionnaires. The findings indicate that older adults' perceptions of their functioning, well-being, disability, and health in general were weakly associated with their cognitive function. Even though the associations were weak, these findings provide new insight for the nursing literature. To date, only one study found subjectively and multidimensionally evaluated health status accounting for significant amount of variance in cognitive function in the elderly (Marri et al., 2001). More importantly, the findings in the

current study came from analyzing both objectively tested and subjectively assessed cognitive function variables.

The environmental changes framework is in early developmental stage of theory. It might be possible to strengthen the framework by integrating other theories or models into it, or adding more explanatory variables. For example, retirement status and social isolation could be added to the framework since these factors are believed to influence cognitive function (Arbuckle, Gold, & Andres, 1986; Avorn, 1983). Interactive relations among various explanatory variables and cognitive function call for further investigation. What becomes clear from this study is that age-related changes in cognitive function should be studied in the context where an individual is living as well as how the individual is perceiving.

The concept of health was broadly defined in this study. Health was argued to be a representation of all the changes including an older adult's maturational changes and environmental changes. Even though health was assessed in eight aspects with the eight health scales in SF-36, these may not have been adequate in terms of capturing all of the changes that happen in various ways. It is not clear, for example, how changes in the environment surrounding an individual interact with other changes happening inside of the individual. Furthermore, the current study with a cross-sectional design lacks the sensitivity to capture all the changes that happen as people age. Since the environmental changes framework emphasizes the effect of changes on cognitive function, future research should incorporate repeated measurements of health and cognitive function.

Nursing Practice

The clinical findings of greatest relevance here are related to the participants' perception of "Change". The older adults, aged 75 or older, perceived their memory abilities to be worsening more so than those older adults, aged 65 to 74. At the same time the older adults, aged 75 or older, performed everyday memory tasks more poorly than those aged 65 to 74. In other words, the more change older adults perceived, the more poorly they performed on everyday memory tasks. Since this was a correlational study with a cross-sectional design, it is not clear to see cause and effect between older adults' perception of change and performance on everyday memory tasks. Nevertheless, this is useful information as this may indicate an impending, early stage of dementia (Gilewski & Zelinski, 1986). This is in accordance with what has been reported elsewhere in the literature. When an individual complains of memory problems, the person has an average of twice the likelihood of experiencing difficulty on a memory test (Bassett & Folstein, 1993). Examples of the everyday memory tasks used in the current study were remembering people's names, things that were put away earlier, appointments, pictures, and stories. Since everyday memory tasks are essential for independent living in the community, nurses should be especially aware of the importance of memory complaints. Nurses need to plan interventions for older adults who complain of memory problems since these adults will may well have actual problems with cognitive functioning, at least at some point in near future.

Since cognitive function decreases as an individual ages, it is essential to develop a routine practice of assessing older adults' cognitive function, especially the individuals with memory complaints. Such an assessment would be capable of providing valuable documentation of age-related changes in cognitive function. When nurses keep evaluating the memory performance of aged clients, this information could be used to understand older adults' cognitive changes and, therefore, to improve nursing care. Nurses will know when an older adult reconsiders driving, cooking, traveling, or other activities that are considered to be dangerous for an individual with memory problems. As an example, MMSE scores from community-dwelling individuals with dementia could be used as an indication of driving capability. The mean MMSE score from older adults who were still driving was significantly higher than that of older adults who stopped driving (Lucas-Blasustein, Filipp, Dungan, & Tune, 1989).

FINAL SUMMARY

This study provided new knowledge regarding the relationship between subjective health, evaluated with two measures, and cognitive function, assessed with three instruments that have ecological validity, in older adults aged 65 or older, while examining the psychometric characteristics of the two health measures as used in relation to older adults' cognitive function. It is hoped that future studies may be able to profit from a review of the findings and limitations of this study.

Appendix A. Human Subject Approval Document



OFFICE OF RESEARCH SUPPORT & COMPLIANCE
THE UNIVERSITY OF TEXAS AT AUSTIN

P.O. Box 7426, Austin, Texas 78713 (512) 471-8871 - FAX (512) 471-8873
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Date: 3/11/2003

PI(s): **Graham J McDougall**
Jeonghee Kang

Department & Mail Code: **NURSING SCHOOL**
NURSING SCHOOL

D0109
D0100

Dear: **Graham J McDougall Jeonghee Kang**
IRB APPROVAL - IRB Protocol # **2003-03-0048**

Title: **Investigating psychometric characteristics of two versions of a health measure
in relation to older adults' cognitive function**

In accordance with Federal Regulations for review of research protocols, the Institutional Review Board has reviewed the DRC's exempt status assessment of the above referenced protocol and found that it meets Exempt Approval under the category designated below for the following period:

Your study has been approved from **03/11/2003 - 03/11/2004**

Exempt Category of Approval:

- ☐ 1. Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as:
 - (i) research on regular and special education instructional strategies; or
 - (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.
- ☐ 2. Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless:
 - (i) Information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and
 - (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subject's financial standing, employability, or reputation
- ☐ 3. Research involving the use of educational tests, survey or interview procedures, or observing public behavior that is not exempt under number 2 above, if the subjects are public officials or candidates for public office or a federal statute requires that the confidentiality of personally identifiable information will be maintained throughout the research and thereafter.
- ☒ 4. Research involving the collection or study of existing data, documents, records, pathological or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, either directly or through identifiers linked to the subjects. To qualify for this exemption, the data, documents, records or specimens must be in existence before the project begins.
- ☐ 5. Research and demonstration projects which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine:
 - (i) Public benefit or service programs;
 - (ii) procedures for obtaining benefits or services under those programs;
 - (iii) possible changes in or alternatives to those programs or procedures; or
 - (iv) possible changes in methods or levels of payment for benefits or services under those programs.

Appendix A. (continued)

IRB Protocol # 2003-03-0048

Approval Dates: 03/11/2003 - 03/11/2004

☐ 6. Taste and food quality evaluation and consumer acceptance studies, involving adults only.

_____ Please use the attached approved consent forms

_____ You have been granted Waiver of Documentation of Consent

According to 45 CFR 46.117, an IRB may waive the requirement for the investigator to obtain a signed consent form for some or all subjects if it finds either:

_____ The research presents no more than minimal risk

AND

_____ The research involves procedures that do not require written consent when performed outside of a research setting

45 CFR 46.117(c)(2)

or

_____ The principal risks are those associated with a breach of confidentiality concerning the subject's participation in the research

AND

_____ The consent document is the only record linking the subject with the research

45 CFR 46.117(c)(1)

☒ You have been granted Waiver of Informed Consent

According to 45 CFR 46.116(d), an IRB may waive or alter some or all of the requirements for informed consent if:

☒ The research presents no more than minimal risk to subjects;

☒ The waiver will not adversely affect the rights and welfare of subjects;

☒ The research could not practicably be carried out without the waiver; and

☒ Whenever appropriate, the subjects will be provided with additional pertinent information after they have participated in the study.

RESPONSIBILITIES OF PRINCIPAL INVESTIGATOR FOR ONGOING PROTOCOLS:

- (1) Report **immediately** to the IRB any severe adverse reaction or serious problem, whether anticipated or unanticipated.
- (2) Report any significant findings that become known in the course of the research that might affect the willingness of subjects to continue to take part.
- (3) Insure that only persons formally approved by the DRC enroll subjects.
- (4) If relevant to your study, please use **only** a currently approved consent form (remember approval periods are for 12 months or less).
- (5) **Protect the confidentiality of all personally identifiable information collected and train your staff and collaborators on policies and procedures for ensuring confidentiality of this information.**
- (6) Submit for review and approval by the IRB all modifications to the protocol or consent form(s) prior to the implementation of the change.
- (7) Please note that this office will send out a reminder prior to the end of your approval period (typically at the end of the 12 months). At this time we will ask you to give us an update on whether the study is still in progress and/or has had any changes that need to be reviewed for approval.
- (8) Notify the IRB and the DRC when the study has been completed and complete the Final Report Form.
- (9) Please help us help you by including the above protocol number on all future correspondence relating to this protocol.

Thank you for your help in this matter.

Sincerely,



Clarke Burnham, Ph.D., Chair
Institutional Review Board *cb*

cc: DRC

Appendix B. Medical Outcomes Study Short Form 36-item Health Survey (SF-36)

Your Health and Well-Being

This survey asks for your views about your health. This information will help keep track of how you feel and how well you are able to do your usual activities. *Thank you for completing this survey!*

For each of the following questions, please mark an ☐ in the one box that best describes your answer.

1. In general, would you say your health is:

Excellent	Very good	Good	Fair	Poor
☐	☐	☐	☐	☐

2. Compared to one year ago, how would you rate your health in general now?

Much better now than one year ago	Somewhat better now than one year ago	About the same as one year ago	Somewhat worse now than one year ago	Much worse now than one year ago
☐	☐	☐	☐	☐

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Appendix B. (continued)

3. The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

	Yes, limited a lot	Yes, limited a little	No, not limited at all
a Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports	☐	☐	☐
b Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	☐	☐	☐
c Lifting or carrying groceries	☐	☐	☐
d Climbing several flights of stairs	☐	☐	☐
e Climbing one flight of stairs	☐	☐	☐
f Bending, kneeling, or stooping	☐	☐	☐
g Walking more than a mile	☐	☐	☐
h Walking several blocks	☐	☐	☐
i Walking one block	☐	☐	☐
j Bathing or dressing yourself	☐	☐	☐

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Appendix B. (continued)

4. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

	Yes ▼	No ▼
a. Cut down on the <u>amount of time</u> you spent on work or other activities.....	☐	☐
b. <u>Accomplished less</u> than you would like.....	☐	☐
c. Were limited in the <u>kind</u> of work or other activities.....	☐	☐
d. Had <u>difficulty</u> performing the work or other activities (for example, it took extra effort).....	☐	☐

5. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?

	Yes ▼	No ▼
a. Cut down on the <u>amount of time</u> you spent on work or other activities.....	☐	☐
b. <u>Accomplished less</u> than you would like.....	☐	☐
c. Did work or other activities <u>less carefully</u> than usual.....	☐	☐

Appendix B. (continued)

6. During the past 4 weeks, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?

Not at all	Slightly	Moderately	Quite a bit	Extremely
▼ ☐	▼ ☐	▼ ☐	▼ ☐	▼ ☐

7. How much bodily pain have you had during the past 4 weeks?

None	Very mild	Mild	Moderate	Severe	Very Severe
▼ ☐	▼ ☐	▼ ☐	▼ ☐	▼ ☐	▼ ☐

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

Not at all	A little bit	Moderately	Quite a bit	Extremely
▼ ☐	▼ ☐	▼ ☐	▼ ☐	▼ ☐

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Appendix B. (continued)

9. These questions are about how you feel and how things have been with you during the past 4 weeks. For each question, please give the one answer that comes closest to the way you have been feeling. How much of the time during the past 4 weeks...

	All of the time	Most of the time	A good bit of the time	Some of the time	A little of the time	None of the time
1. Did you feel full of pep?	☐	☐	☐	☐	☐	☐
2. Have you been a very nervous person?	☐	☐	☐	☐	☐	☐
3. Have you felt so down in the dumps that nothing could cheer you up?	☐	☐	☐	☐	☐	☐
4. Have you felt calm and peaceful?	☐	☐	☐	☐	☐	☐
5. Did you have a lot of energy?	☐	☐	☐	☐	☐	☐
6. Have you felt downhearted and blue?	☐	☐	☐	☐	☐	☐
7. Did you feel worn out?	☐	☐	☐	☐	☐	☐
8. Have you been a happy person?	☐	☐	☐	☐	☐	☐
9. Did you feel tired?	☐	☐	☐	☐	☐	☐

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Appendix B. (continued)

10. During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting friends, relatives, etc.)?

All of the time	Most of the time	Some of the time	A little of the time	None of the time
▼	▼	▼	▼	▼
☐	☐	☐	☐	☐

11. How TRUE or FALSE is each of the following statements for you?

	Definitely true	Mostly true	Don't know	Mostly false	Definitely false
▼	▼	▼	▼	▼	▼
☐	☐	☐	☐	☐	☐
1. I seem to get sick a little easier than other people.....	☐	☐	☐	☐	☐
2. I am as healthy as anybody I know.....	☐	☐	☐	☐	☐
3. I expect my health to get worse.....	☐	☐	☐	☐	☐
4. My health is excellent.....	☐	☐	☐	☐	☐

Thank you for completing these questions!

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Appendix C. Medical Outcomes Study Short Form 12-item Health Survey (SF-12)

Your Health and Well-Being

This survey asks for your views about your health. This information will help keep track of how you feel and how well you are able to do your usual activities. *Thank you for completing this survey!*

For each of the following questions, please mark an ☒ in the one box that best describes your answer.

1. In general, would you say your health is:

Excellent	Very good	Good	Fair	Poor
▼	▼	▼	▼	▼
☐	☐	☐	☐	☐

2. The following questions are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

Yes, limited a lot	Yes, limited a little	No, not limited at all
▼	▼	▼

* Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf ☐ ☐ ☐

* Climbing several flights of stairs ☐ ☐ ☐

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Appendix C. (continued)

3. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

	Yes	No
» Accomplished <u>less</u> than you would like	☐	☐
» Were limited in the <u>kind</u> of work or other activities	☐	☐

4. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?

	Yes	No
» Accomplished <u>less</u> than you would like	☐	☐
» Did work or other activities <u>less carefully</u> than usual	☐	☐

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

Not at all	A little bit	Moderately	Quite a bit	Extremely
☐	☐	☐	☐	☐

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Appendix C. (continued)

6. These questions are about how you feel and how things have been with you during the past 4 weeks. For each question, please give the one answer that comes closest to the way you have been feeling. How much of the time during the past 4 weeks...

All of the time	Most of the time	A good bit of the time	Some of the time	A little of the time	None of the time
▼	▼	▼	▼	▼	▼

» Have you felt calm and peaceful? ☐ a ☐ b ☒ c ☐ d ☐ e ☐ f

» Did you have a lot of energy? ☐ a ☐ b ☐ c ☐ d ☐ e ☐ f

» Have you felt downhearted and blue? ☐ a ☐ b ☐ c ☐ d ☐ e ☐ f

7. During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting friends, relatives, etc.)?

All of the time	Most of the time	Some of the time	A little of the time	None of the time
▼	▼	▼	▼	▼
☒ a	☐ b	☐ c	☐ d	☐ e

Thank you for completing these questions!

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Appendix D. Mini-Mental State Examination (MMSE)

MMSE Sample Items

Orientation to Time: “What is the date?”

Registration: “Listen carefully, I am going to say three words. You say them back after I stop. Ready? Here they are... HOUSE (pause), CAR (pause), LAKE (pause). Now repeat those words back to me.” [Repeat up to 5 times, but score only the first trial.]

Naming: “What is this?” [Point to a pencil or pen.]

Reading: “Please read this and do what it says.” [Show examinee the words on the stimulus form.] CLOSE YOUR EYES

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Appendix E. Rivermead Behavioural Memory Test (RBMT)

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Appendix F. Metamemory in Adulthood Questionnaire (MIA)

MIA Sample Items

Achievement: “It is important to me to have a good memory.”

Anxiety: “I get upset when I cannot remember something.”

Capacity: “I am good at remembering names.”

Change: “I can remember things as well as always.”

Locus: “I can’t expect to be good at remembering zip codes at my age.”

Strategy: “Do you keep a list or otherwise note important dates, such as birthdays and anniversaries?”

Task: “For most people, facts that are interesting are easier to remember than facts that are not.”

Reproduced by special permission by the developers of the Metamemory in Adulthood (MIA). The official citation for the Metamemory in Adulthood questionnaire is this: Dixon, R. A., Hultsch, D. F., & Hertzog, C. (1988). The metamemory in Adulthood (MIA) questionnaire. Psychopharmacology Bulletin, 24(4), 671-688.

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