Concurrent Validity of Functional Reach in Community-Dwelling Elderly Women

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CONCURRENT VALIDITY OF FUNCTIONAL REACH IN COMMUNITY-DWELLING ELDERLY WOMEN

By
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Kimberly Sackett

THESIS

Submitted to the Department of Physical Therapy
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1997
Concurrent Validity of Functional Reach in Community-Dwelling Elderly Women

Abstract

The purpose of this correlational study was to establish concurrent validity of functional reach, the maximal distance one can reach forward beyond arm's length without taking a step, as a measure of physical decline, by determining the relationship between functional reach and other physical performance measures. Subjects included 46 community-dwelling women over 65 years of age who performed the functional reach test, the timed Up and Go, and the 10-foot walk. Data analysis employed Pearson correlation coefficients. The association between FR and timed Up and Go and 10-foot walk was \( r = -0.51 \) and \( r = -0.53 \) respectively. After controlling for age, partial correlation coefficients between FR and timed Up and Go and 10-foot walk were \( r = -0.46 \) and \( r = -0.48 \), respectively (\( p = 0.001 \)). In conclusion, FR showed modest concurrent validity with other physical performance measures.
PREFACE

DEFINITIONS

functional reach (FR): the maximal distance one can reach forward beyond arm's length without taking a step.

physical frailty/decline: diminished physical ability needed to live independently, and associated with an increased risk for falls.

elderly: males or females over 65 years of age.

independent: ability to perform bathing, toileting, and dressing without physical assistance from another individual.

community-dwelling: a person who is living in the community and lives independently.
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CHAPTER ONE

INTRODUCTION

Currently in the United States the elderly population has risen dramatically and there has been a corresponding increase in elderly individuals who experience disability in their lifetime (Blair, Jacobs, & Quiram, 1996). Preserving independence can improve the quality of life in the elderly population and decrease rising health care costs. A startling number of senior citizens will fall each year contributing to both monetary and nonmonetary costs. Numerous studies have shown impairments in balance to be highly correlated with falls in the elderly population (Bernstein & Schur, 1990; Robins et al., 1989). There is no universal geriatric assessment tool that can identify potential risk factors for falls or mobility characteristics that can affect independence. A functional and dynamic balance test proven to be effective is the functional reach test (FR). This test is simple, easy to administer, and cost-effective (Duncan, Weiner, Chandler, & Studenski, 1990).

Statement of the Problem

The problem is a lack of valid and standardized geriatric assessment tools that are useful clinical measures. The functional reach is one tool that has been explored and has be shown to be
reliable and valid in the elderly population in several studies. This study looked at functional reach and compared it with other clinical measures of balance. The lack of validity in assessment tools is specific to the population of elderly women. This study looked at functional reach in a sample of elderly women which has not been previously studied. The following variables were considered in this correlational study:

1. Functional reach in elderly women.
2. Other physical performance measures, such as timed Up and Go and 10-foot walk, in elderly women.

Purpose of the Study

The purpose of this correlational study was to establish concurrent validity of functional reach, as a measure of physical decline, by determining the relationship between functional reach and other physical performance measures. Subjects were elderly women over 65 years of age who performed the functional reach test, the timed Up and Go, and the 10-foot walk. The goal of this study was that the results will prompt physicians and other medical professionals to utilize functional reach as a screen for physical decline among elderly women.

Need for the Study

Studies have established validity and reliability of the functional reach test but have neglected researching elderly women subjects only. No standard that can evaluate independence in a functional manner has been established for the elderly population
according to the functional reach creators (Duncan, Studenski, Chandler, & Prescott, 1992). Despite a shift from a disease-oriented to a function-oriented approach in geriatric assessment, the lack of universal standards in a function-oriented approach has left many useful tools under utilized. Instead, most traditional geriatric assessment tools, such as blood pressure readings, focus on the medical diagnosis leaving little understanding of the patient's functional status. This study is a condensed version of a study designed by the researchers who developed the functional reach test. Specifically, they used functional reach and other physical performance measures as a link to physical frailty in elderly men and women. Therefore, this study will be conducted to determine the value of using functional reach and other physical measures as a screen of function in elderly women only.
CHAPTER TWO

LITERATURE REVIEW

Introduction

Elderly persons in the United States are living longer but many of them are living out their last few years with more disabling conditions. Specifically, more elderly women experiencing physical changes associated with aging are living alone in the community (Cessna, Jacobs, & Foster, 1994). One physical change often associated with the aging process is a change in balance, which involves multiple body systems, such as vision and proprioception, often associated with the aging process (Lewis, 1996). There are numerous studies of balance in the elderly because it has been highly correlated to falling (Robbins et al., 1989). Falls can lead to other physical and psychological changes in the elderly affecting their function and independence.

The high cost associated with falls in the elderly and the rise in health care costs have led many researchers to define a functional geriatric assessment that can predict falls before they occur. Both prospective and retrospective studies of falls in the elderly population have provided balance and mobility measures involving both static and dynamic balance. Functional reach, timed Up and Go, and the 10-foot walk are three tests used in current dynamic balance and
mobility research. These measures are often selected because they: are easy to administer, are functional, measure dynamic stability, correlate with activities common to falling, are suitable for elderly women, and are commonly used (Duncan et al., 1990; Weiner, Bongiorni, Studenski, Duncan, & Kochersberger, 1993; Podsiadlo & Richardson, 1991). A final measure considered in the literature review is the Mini-Mental State Examination used as a screen to assure the subjects are able to follow the verbal commands of the physical measures.

**Demographics of the Aging Population**

Later life is characterized by a unique developmental process instead of a chronological process (Lewis, 1996). The developmental process begins with birth and ends with death. Those over 65 reach the most diverse stage in the developmental process. The elderly population age in unique ways, both as a group and as individuals. This unique growth makes the developmental process different for every older individual. For this reason, research of the geriatric population has and will continue to be a major focus in the field of medicine. Another important reason for geriatric research is the growing proportion of elderly persons in the United States. Elderly people also have more health problems and require more medical care than the younger population (Blair et al., 1996). The above factors have prompted the gathering of various statistics on aged Americans.

In 1900, 4% of the total population was over 65 years old, and in 1993 12.7%. The projected percentage of people over 65 is estimated to be over 20% of the total population in the year 2050.
(Blair et al., 1996). There are three main reasons for the continued increase in the elderly population. First, the "baby boom generation" will turn 65 around the year 2010. This generation was born between 1946 and 1964 and make up one third of all Americans. Secondly, medical technology has reduced infant mortality and the number of deaths from childhood disorders. Other medical advances and life sustaining technologies have increased survival rates. A final reason for the increase in the elderly population is a general trend toward a healthier lifestyle including an increase in exercise and improved dietary habits (Blair et al., 1996). After consideration of the statistical data on the increase of the elderly population, the next step is to define who makes up this population.

Women have a longer life expectancy than men, and in the future they will likely make up an even larger proportion of the population. The life expectancy of an average American born in 1900 was 47 years. In 1993, the life expectancy of an average male was 72.1 years and the average female was 78.9 years. The projection for the year 2000 is 73.5 years for males and 80.4 years for females (Blair et al., 1996). Current gender ratios of all elderly persons over 65 is 68.5 males for every 100 females (U.S. Bureau of the Census, 1995). As a result of gender differences in life expectancy, almost one half of women 65 and over were widows in 1990 (Cessna et al., 1994). Statistics from 1994 show 78% of men over 65 were married while only 52% of women over 65 were married. The reason for more women being widowed and the difference in marital status between men and women include: women live longer than men, men tend to marry younger women, and men
who are widowed or divorced are more likely to remarry than women in the same circumstances (Blair et al., 1996). As well as defining the elderly population, it is also important to review the demographics of where and with whom the elderly population lives.

It is estimated that 95% of the elderly population live in the community while only 5% live with assistance (Blair et al., 1996). In 1993, 74.6% of noninstitutionalized men 65 and over lived with their spouses, while only 40.6% of noninstitutionalized women 65 and over lived with their spouses. The percentage of persons living alone increases with age and with the female gender. Approximately 31% of women between the ages of 65 and 74 and 52% of women over 74 lived alone in 1994 (Blair et al., 1996). Although most older persons prefer to remain independent and functional, a number of pathologies and impairments, such as in balance, often accompany the aging process and can make living alone difficult.

Balance impairments affecting function and independence have relevance to the elderly population. A number of studies have described the impairments of balance in the elderly and have shown the correlation between changes in balance and falls. Standing balance has been shown to decline with age (Bohannon, Larkin, Cook, Gear, & Singer, 1984), and the risk of falling increases with age and is greater in women (Teno, Kiel, & Mor, 1990). In the community, approximately 30% of people over 65 will fall each year (Campbell, Borrie, & Spears, 1989; Tinetti, Speechley, & Ginter, 1988).

A fall by a community-dwelling older person may result in long-term or short-term care needs, restricted activity, unintentional
injury, fear of falling, or death (Nevitt, Cummings, Kidd, & Black, 1989). A leading cause of death for persons over 65 is unintentional injury, which often results from falls (Bernstein & Schur, 1990). The final result of a fall can include both monetary and nonmonetary costs. A nonmonetary cost may include loss of function and psychological consequences (Nevitt et al., 1989). Monetary costs are often the forefront of concern and thus provide many of the available statistics.

The cost and need of health care are higher in the elderly population as a result of more health problems than younger persons (Cessna et al., 1994). The increase in health problems often lead to physical frailty, which includes impairments in physical abilities affecting independent living and increases the risk for falls. Frailty among the elderly is predominantly found in women. The frail elderly living in the community have, on an average, health care costs that are 2.2 times more than elderly persons without frail disabilities. In a report to the U.S. Congress in 1991, the Department of Health and Human Services reported annual costs from frailty to be between 54 and 80 billion dollars. The cost from frailty is estimated to be 132 billion dollars by the year 2030 (U.S. Department of Health and Human Services, 1991).

Although the total elderly population make up only 13% of the US population, they account for 30% of all health care costs (Blair et al., 1996). It is estimated by the year 2030, the elderly population will make up 20% of the total population and will use 50% of all health resources. According to the National Institute of Medicine, the nation could save three billion dollars a year in health care costs, by
delaying the time an elderly individual requires a nursing home by one month (Blair et al., 1996).

The serious problem of health care cost, especially in the elderly, led to a proposed solution presented in a report called Healthy Population 2000 (U.S. Department of Health and Human Services [DHHS], 1992). In 1992, this report stated objectives for national health promotion and disease prevention in the aged. The objectives described here will relate to the elderly demographics previously discussed. The first objective was to "reduce deaths among people aged 65 through 84 from falls and fall-related injuries to no more than 14.4 per 100,000" (DHHS, 1992, p. 588). The same objective for people aged 85 and older was no more than 105 per 100,000 deaths. A second goal was a minimum of 65 years of healthy life. Finally, an objective was established to preserve independence for those people aged 65 and over who have problems in performing two or more personal care activities (DHHS, 1992). The goals set by the U.S. Department of Health and Human Services were introduced because of the demographic statistics such as those found in this section.

The dramatic rise in life expectancy and the increasing elderly population have important implications for maintaining functional independence. This independence is especially important for women who may live alone in the community and are vulnerable to physical decline. The objectives described above are based on the following statement: "Although it is commonly believed that health problems in old age are inevitable, many are in fact preventable or can be
controlled" (DHHS, 1992, p. 587). Statistics collected in the future will determine if these objectives can and will be achieved.

**Geriatric Assessment**

A comprehensive functional geriatric assessment is defined as "a multidisciplinary evaluation in which the multiple problems of older persons are uncovered, described, and explained, if possible, and in which the resources and strengths of the person are catalogued, need for services assessed, and a coordinated care plan developed to focus interventions on the person's problems" (Solomon, 1988, p. 342). The components of a geriatric functional assessment include an evaluation of cognition, psychosocial issues, special senses, evaluation of activities of daily living (ADL), and mobility (Gallo, Reichel, & Andersen, 1995).

Geriatric assessment was first documented in the United Kingdom during the 1930's by physicians who observed few elderly patients who had received any assessment from medical, psychological, or social perspectives. The physicians' experience led to functional health benefits resulting from a multidimensional review of elderly patients. The success of these physicians eventually led to the emergence of geriatrics as a specialty field (Guralnik, Branch, Cummings, & Curb, 1992). As a result of these original findings, the art and science of geriatric assessment has developed in other countries with common goals. These goals include the improvement of care outcomes, quality of life, and function (Guralnik et al., 1992; Rubin, Sizemore, Loftis, & Loret de Mola, 1993).
Through the development of geriatric assessment came a disease-oriented approach used in traditional medical practice (Fleming, Evan, Weber, & Chutka, 1995). This approach involves the time-honored tradition of taking a thorough history, nonselective physical examination, and appropriate laboratory and diagnostic tests (Tinetti, 1986). The clinician then attempts to obtain the necessary data from these tests to define the underlying pathophysiology and expected functional status. However, the standard physical examination provides a limited assessment of mobility and function (Applegate, Blass, & Williams, 1990). As a result, the physicians' approach to geriatric assessment has recently shifted from disease-oriented to function-oriented (Fleming et al., 1995).

Specific limitations with the traditional medical approach helped to define the shift in medical care. First, the elderly often exhibit complex medical conditions, atypical presentations, and are especially vulnerable to iatrogenesis (Solomon, 1988). Another limitation with the traditional approach is distinguishing changes of normal aging from changes associated with pathology in the elderly (Guralnik & Simonsick, 1993). Lastly, there is no assured correlation between medical diagnosis and functional status (Almy, 1988). A clinician may acquire a great deal of data and have no understanding of the patient's functional mobility status (Tinetti, 1986). For example, an elderly person may have one or more chronic conditions, but be able to function without outside help. Another elderly person with the same chronic conditions may suffer from more severe functional impairments. Continued support for the shift in assessment has been shown in studies which used comprehensive
functional assessment to show prolonged survival, reduced annual medical costs, and improved functional status (Guralnik et al., 1992; Liem, Chernoff, & Carter, 1986; Rubin et al., 1993).

Despite the development of many valid and reliable geriatric assessment scales (Gallo et al., 1995), many of these scales were designed for research purposes and are often impractical for use in clinical care (Applegate, 1987). Therefore, the need to include performance-oriented functional assessments, such as the ability to rise from a chair, standing balance, and turning balance, was recognized (Tinetti, 1986). A simple and direct assessment of routine mobility maneuvers should be used in the clinical care of elderly patients. Functional reach is one example of a simplified and efficient assessment tool used to determine functional deficits in older patients (Fleming et al., 1995).

A simplified assessment benefits physicians, elderly patients, and other health professionals. As mentioned earlier, results on geriatric functional assessments benefit elderly patients through outcomes such as prolonged survival. These results have also been shown to reduce use of acute hospitals and nursing homes (Solomon, 1988). These two outcomes are the most consistently demonstrated findings across comprehensive geriatric assessments. Another consistent outcome variable includes reduced annual medical care costs which can benefit both the elderly and the community (Solomon, 1988). Continued research is needed to provide Medicare and other agencies evidence to recognize functional assessment of the elderly as a discrete procedure qualifying for reimbursement (Almy, 1988).
Physicians may also benefit from geriatric assessment for two important reasons. First, many primary physicians are allowed extremely low fees under current payment practices for elderly assessment (Almy, 1988). Insurance agencies may provide specific incentives for use of an appropriate functional assessment tool and may be willing to reimburse physicians. This would allow physicians to determine the functional level and medical diagnosis as needed for individual elderly patients. The second benefit for physicians involves improved recognition of impairment through functional assessment instruments compared with clinical judgment. Although physicians may be able to recognize severe impairment, the identification of more prevalent moderate impairments have been shown to be poor (Pinholt et al., 1987). A study by Elam et al. (1989) found limited understanding of patient's function when comparing physician's report to observation of functional tasks. Therefore, physicians who use geriatric functional assessments appropriately may receive increased reimbursements and a more accurate recognition of impairment.

Although the benefits of a comprehensive geriatric assessment seem complete, problems with the assessment exist. Lack of consistent use of geriatric assessments in research across the United States and the world offer varied results. For example, components of a geriatric functional assessment can vary according to a patient's needs in different environments. These environments may include outpatient, inpatient, rehabilitation, or long-term care facilities. Another example of the lack of uniformity involves the mode of administration. Assessments can be administered by a variety of
health professionals with or without the appropriate experience, which can provide inconsistent results. A final problem described earlier involves the application of research findings to a clinical setting because research is often performed outside the clinical setting (Applegate et al., 1990).

**Balance**

Balance, also known as postural control, is defined as the ability to sustain postural stability by maintaining or returning the center of gravity over the base of support (Lewis, 1996). Maintaining balance is an intricate process and is needed for everyday activities. Functional independence relies on the person's ability to maintain, assume, and move within and between postures. For this ability to exist, coordinated responses to stimuli must be transmitted to the appropriate muscles. For example, functional balance is required during bilateral stance to free the upper extremities for activities such as grooming, dressing, and cooking. Balance is also necessary for unilateral stance. Unilateral stance is utilized in activities such as gait, climbing stairs, stepping over obstacles, and lower body dressing. Without sufficient balance during bilateral or unilateral stance, an individual will be more likely to fall unless support is given either through the upper extremities or assistance from another individual (Lewis, 1996).

The maintenance of balance is dependent on three components of performance: sensory, perceptual, and motor (Lewis, 1996). The sensory elements, which comprise the first component, includes the visual, somatosensory, and vestibular systems. The visual system
detects the orientation of body parts and of the body with reference to the external environment. Vision also helps guide movement with respect to maintaining balance. Cutaneous sensations from body parts that remain in contact with the support surface and muscle and joint receptors provide somatosensory input. These receptors detect movement of body parts and determine the orientation of the support surface (O'Sullivan & Schmitz, 1994). The vestibular system identifies angular and linear accelerating and decelerating forces that act on the head. This system also provides orientation of the head in relation to gravity (O'Sullivan & Schmitz, 1994).

The second component of balance is perceptual integration. The central nervous system (CNS) is responsible for the organization of sensory input. Perceptual integration occurs when the CNS weighs and uses the inputs as needed, however, it is flexible and can respond correctly to conflicting sensory input. Generally, with a stable support surface and surroundings, balance is primarily maintained through somatosensory inputs. However, if the support surface becomes unstable the CNS relies on the visual input. If both the support surface and vision are disturbed, vestibular inputs become dominant and provide the necessary information to resolve the sensory conflict (Shumway-Cook & Horak, 1986). Balance can be maintained with the absence of one sensory system because of the redundancy of the other two inputs, however, if more than one sensory system is deficient a lack of balance control will be evident (O'Sullivan & Schmitz, 1994).

The third component of balance is made up of musculoskeletal responses for motor performance. These responses vary from simple
monosynaptic stretch reflexes to full-scale equilibrium reactions. Musculoskeletal responses are demonstrated by various patterns of leg and trunk muscular contractions known as strategies. These strategies are characterized by specific muscle combinations, timing and intensity, which are used to preserve standing balance. The ankle strategy, a musculoskeletal response, involves shifting the center of mass forward and back about the ankle joints. The ankle strategy is used most effectively with small postural disturbances. The hip strategy involves shifts in the center of mass by flexing or extending at the hips and is utilized with larger disturbances. The stepping strategy moves the base of support under the center of mass by using rapid steps. This strategy is utilized when the ankle or hip strategies are no longer effective in maintaining postural control (O'Sullivan & Schmitz, 1994). Postural synergies and reactions are influenced by past experience, sensory inputs, the parameters of the disturbing stimulus, and the body position at the time of imbalance (O'Sullivan & Schmitz, 1994).

Many factors can influence the speed and accuracy of the postural response in maintaining balance. Such factors include receptor threshold, the speed of transmission to the CNS, the central interpretation, the centrally controlled feed-forward mechanism, the activation of adequate motor response, and the appropriate musculoskeletal execution of that response. If problems or deficiencies exist at any of these levels, the person may fall as a result of her inability to adequately maintain postural control (Sullivan & Markos, 1995).
Balance and Mobility Measures

Balance has consistently been reported to decrease with age as a result of variable deficiencies in the factors influencing postural control (Lewis, 1996). The normal aging process along with pathological processes are mostly responsible for this decline in balance. Many studies have found as balance decreases the likelihood of a fall increases (Duncan et al., 1992; Maki, Holliday, & Fernie, 1990; Tinetti M.E., Williams, & Mayewski, 1986). One third to one half of the population over 65 years old will fall at least once each year, and women tend to have a greater frequency of falls compared to men (Nickens, 1985). Many studies have focused on identifying risk factors for falls, and the impairment of balance has been consistently reported as a major risk factor (Perlin, 1992; Reinsch, MacRae, Lachenbruch, & Tobis, 1992; Studenski, Duncan, & Chandler, 1991).

In general, falls in the elderly population are the result of a multifactorial event (Speechley & Tinetti, 1991). In most cases falls are caused by the interplay of intrinsic and extrinsic factors. Extrinsic factors involve environmental hazards which could cause a fit and active person to fall or increase the risk of a frail person to fall. Intrinsic factors are those caused by normal aging and or pathological processes (Campbell et al., 1989). With increasing age the intrinsic factors become more important determinants of falls while the environmental hazards play a smaller role (Nickens, 1985; Sjorgen & Bjornstig, 1991). Main intrinsic factors that have been repeatedly reported include: balance impairments, muscle weakness, visual impairments, orthostatic hypotension, and the use of medications.
As people age, their medical profile usually becomes complicated with multiple chronic conditions, which is then coupled with the changes of the normal aging process, thus creating intrinsic factors. This multifaceted reality has made it difficult to accurately locate the primary cause of physical impairments such as changes in balance. No matter what the cause, balance impairments are directly related to a person's stability; therefore, many attempts have been made to develop the ideal balance and or mobility measure to accurately determine the patient's level of stability.

Without reliable and valid measures for assessing balance and mobility, it is difficult to assess treatment efficacy and monitor a patient's improvement over time. Currently, there is no accepted "gold standard" in measuring balance or mobility; therefore, new measures, if valid, must be correlated to existing measures (Berg, Maki, Williams, Holliday, & Wood-Dauphine, 1992). Two main approaches have been taken in the process of developing a new measure, laboratory and clinical.

The first type of testing usually takes place in a laboratory. An example of the laboratory approach, posturography, records postural sway while the patient stands on a force measuring platform. Biomechanic platforms measure sway as the movement of the center of gravity, and is projected on a horizontal plane with the subject standing still. This process is termed center of force or center of pressure (Lichtenstein, Shields, Shiavi, & Burger, 1988). Posturographic measurements are thought to improve the ability to
identify more subtle balance impairments (Maki et al., 1990). A study conducted by Maki et al. (1990) compared measurement of spontaneous sway during quiet standing and measurement of induced postural sway in response to an applied perturbation. The authors predicted induced postural sway would more closely simulate actual falling circumstances, and therefore distinguish fallers, however their results showed spontaneous-sway measures were more successful in identifying fallers from nonfallers. Despite this difference, both induced and spontaneous-sway measures demonstrated significant age related decreases in postural stability (Maki et al., 1990).

A study conducted by Topper, Maki, & Holliday (1993) supported the use of the laboratory balance measure, posturography. They compared an activity based test of balance and gait to a posturography test to predict the risk of falling. The study's results demonstrated measures of posturography were more accurate predictors of falls than the clinical based measures. The authors concluded the posturography test could be suitable as a quick and simple screen, given the necessary instrumentation is available (Topper et al., 1993).

Different results have been shown by other studies. Lichtenstein, Burger, Shields, & Shiavi (1990) compared the association between sway measures obtained with a biomechanic platform and gait measures obtained from videotape of performance on Tinetti's clinical mobility index in community-dwelling elderly women. The noted advantages of the mobility index included portability and ease of application. In contrast to the advantages of the mobility index, the authors conveyed biomechanic measures may
be more precise and less dependent on observer variability, especially in conducting follow-up measurements. Due to modest correlations, they concluded the two techniques may be measuring different components of balance and gait. The platform measures static balance while the mobility index is based on dynamic activity. The study supported future research of a combination of the two techniques to assess their individual contributions (Lichtenstein et al., 1990).

A separate study supported a combination of clinical and laboratory measures for fall risk prediction. Thapa, Gideon, Fought, Kormicki, & Ray (1994) also compared clinical and biomechanical measures of balance and mobility; however, in their study they targeted elderly nursing home residents. They found a high correlation between the clinical measures (functional reach, timed chair stands, Tinetti's mobility index, and timed 10-foot walk) and biomechanical measures (postural sway characterized by elliptical area and mean velocity) separately, but they did not correlate well with each other. The study confirmed that the two approaches may measure different components of postural control. They concluded the biomechanical measures were not superior in validity to the more simple clinical measures.

The clinical measures noted in the previous study define the second main approach in measuring postural control and mobility. As mentioned earlier, clinical measures tend to be portable, less expensive, and easier to administer (Lichtenstein et al., 1990). Static measures of balance were the first to appear in the evolution of quantitative clinical methods (Chandler, Duncan, & Studenski, 1990),
and were developed as early as 1851 (Briggs, Grossman, Birch, Drews, & Shaddeau, 1989). One-footed stance, Romberg tests, and postural stress tests are examples of static measures. Conditions of these tests can also vary as with one-legged stance with eyes open or closed. Gehlsen and Whaley (1990) found timed static balance through one-legged stance was a factor that distinguished elderly fallers from nonfallers. Although static balance measures are time efficient, inexpensive, require no special equipment and are simple to administer (Briggs et al., 1989), some researchers stated these tests might not be sensitive enough to distinguish changes in functional status (Heitman, Grossman, Shaddeau, & Jackson, 1989). Studies have shown the majority of the falls in the elderly occur during some form of activity (Gabell, Simons, & Nayak, 1985). This idea has directed much research towards using dynamic clinical balance measures.

In response to the need for dynamic balance and mobility instruments an overwhelming number of measures were developed (Duncan et al., 1992). Not only were these new measures dynamic, but they concentrated on function-oriented activities. Information regarding function was derived from direct observation, self-report, and proxy report scales (Reuben & Siu, 1990). The following is a brief sampling of the many dynamic function-oriented instruments.

Tinetti's (1986) research focused on the development of balance and gait performance tests in which the examiner observes the patient perform the various tasks. This instrument consists of eight position changes (sitting balance, rising from a chair, immediate and prolonged standing balance, withstanding a nudge on the
sternal, balance with eyes closed, turning balance, and sitting down) as well as eight gait observations (initiation, step height and length, step continuity, symmetry, path deviation, trunk sway, walking stance, and turning while walking). Tinetti (1986) states,

observing the individual perform these everyday maneuvers provides more useful information diagnostically, therapeutically, and prognostically, than indirect and nonspecific tests such as the Romberg maneuver. The primary care physician or geriatric consultant is not looking at gait to analyze meticulously every component, but rather to detect obvious problems, observe function, and identify potential measurements for improvement (p. 123).

A study conducted by Tinetti, Williams et al. (1986) concluded the mobility test was the best single predictor of fall risk. It was also useful because of its simplicity, recreated fall situations, and it provided dynamic assessment of mobility. Limitations of the above balance and gait observations include vague categorizations, questionable reliability, difficulty reproducing the environment, and they do not take into consideration a person's mobility level may result from a complex set of interactions among intrinsic and extrinsic factors (Tinetti, 1986).

Another function-oriented instrument, the Physical Performance Test (PPT), developed by Reuben and Siu (1990) assesses multiple domains of physical function by observing the performance of simulated activities of daily living of various degrees of difficulty. The nine-item scale includes writing a sentence, simulated eating, turning 360 degrees, putting on and removing a
jacket, lifting a book and putting it on a shelf, picking up a penny from the floor, a 50-foot walk test, and climbing stairs. The authors claim the test takes only ten minutes to complete and requires only a few simple props. The PPT was found to be reliable and demonstrated concurrent and construct validity (Reuben & Siu, 1990). Another study in support of the PPT found it might be a valid indicator of mild degrees of impairment; therefore, it could detect the need for intervention before disability was apparent (Rozzini, Frisoni, Bianchetti, Zanetti, & Trabucchi, 1993). While the PPT directly observes ADL performance, other measures rely on patient or proxy-report.

Self-report measures, such as Katz Basic Activities of Daily Living (BADL) and Lawton-Brody Instrumental Activities of Daily Living (IADL), are another type of function-oriented assessment tool. These tests ask patients whether they could or actually do perform various tasks or activities. An advantage of self-report measures is the patients can complete the scale at home at their convenience. These scales are also cost-effective, do not rely on props and require no examiner training (Reuben & Siu, 1990). A major complaint regarding self-report function scales was they did not consider the majority of elderly people who were able to complete their ADL's but were still at risk for disability. They were able to differentiate functioning at the very disabled end of the spectrum (Rozzini et al., 1993). Validity has also been known to be compromised in self-report instruments when they do not apply strict definitions and potential response categories for the activity being assessed (Guralnik et al., 1992).
Performance-based measures of function generally offer the advantage of overcoming several limitations of the self-report scales (Rozzini et al., 1993) such as clearer face validity, better reproducibility, greater sensitivity to change, and less influence of culture and education (Guralnik et al., 1992). Rozzini et al. (1993) compared the ability of the self-report measures, BADL and IADL, to the PPT to detect health status impairments. In their study the performance-based measure was more closely associated with markers of health than self-reported ADL scales (Rozzini et al., 1993). The disadvantages of performance-oriented measures include: they are more time consuming, adequate space and special equipment may be needed, special training of examiners is required; there is potential for injuries, and the simple tests may not reflect performance on complex tasks. Furthermore, these tests may not provide specific information on whether the identified limitations hold any relevance to actual activities or needs of the individual, or how well the patient has adapted to his individual environment (Guralnik et al., 1992).

Regardless of all the advantages and disadvantages, both performance-based and self-report scales are valuable to the field of geriatric assessment. As stated by Guralnik et al. (1989), "By understanding the functional capacities of patients, caregivers are better able to judge disease severity, the impact of multiple morbidity, and the need for rehabilitation and support services" (p. 141). Although, maintenance of health and quality of life are necessary for the prevention of disability in the elderly, the measurement of balance and function continues to challenge investigators (Lichtenstein et al.,
1990). As a result of the vast number of instruments developed in the field of health assessment, no instruments have become standards for the field (Guralnik et al., 1992). Further research is needed in this arena to help health care professionals determine which assessment measure is optimal.

**Functional Reach**

The high prevalence of falls and impaired mobility in the elderly demanded geriatric assessment to include a cost-effective and easily administered measure of balance. In response to this need, the functional reach test was developed as a new clinical measure of balance (Duncan et al., 1990). Further need for its development stemmed from the multiple limitations of other balance measures.

Some measures of balance such as tandem walking or one-footed stance were difficult to perform even for healthy individuals (Donahoe, Turner, & Worrell, 1994). Other measures such as the platform perturbation and center of pressure excursion, although objective and precise, were complicated and often involved sophisticated equipment which made them impractical for use in the clinic (Donahoe et al., 1994; Duncan et al., 1990; Thapa et al., 1994). Various tests utilized an ordinal scoring system which was unable to discriminate between levels of postural impairment unlike a continuous scoring system used in the FR test (Duncan et al., 1990). Another limitation of balance measures such as the Romberg test and one-footed stance was the measurement of static balance only (Donahoe et al., 1994; Duncan et al., 1990). Duncan et al. (1990) stated "dynamic balance measures, which assess the ability to
maintain equilibrium in response to either self-motivated or external perturbation, are superior to static tasks" (p. 192). Dynamic balance skills, as opposed to static, more closely simulate functional activities in which one could lose her balance (Weiner et al., 1993).

With the previous limitations in mind, the goal for Duncan et al. (1990) was to develop a measure that utilized a continuous scoring system, was easy to administer, and was practical for the clinic. The researchers defined functional reach as "the maximal distance one can reach forward beyond arm's length (in the horizontal plane), while maintaining a fixed base of support in the standing position" (Weiner et al., 1993, p. 796). Functional reach was measured using a yardstick secured to a wall at the height of the acromion. The intent of the FR was to measure the margin of stability, which was similar in theory to center of pressure excursion (COPE). Duncan et al. (1990) evaluated whether standing FR did in fact measure a person's margin of stability by comparing the results with COPE measurements. A force platform was used to measure COPE and a yardstick to measure FR in 128 volunteers with a range of 21-87 years of age. They found FR measures strongly associated with COPE measurements with a correlation of 0.71. Test-retest reliability of FR was high (intraclass correlation coefficient (ICC) = 0.92) as was interrater reliability (ICC = 0.98). They also found the FR to be age sensitive; as age increased the FR decreased (Duncan et al., 1990).

In addition to the age-sensitive quality in the adult population, the FR measurement was quantitative, inexpensive, easily applied in the clinical setting, and relevant to a variety of functional settings. Therefore, development of the functional reach test proceeded
through distinct phases. Initially, FR was found to be reliable, including test-retest reliability, intrarater reliability, and interobserver reliability. It was also found to be quantitative and easy to administer (Duncan et al., 1990). Once the first phase was complete, the second phase was to establish concurrent validity in 45 community-dwelling elderly as a marker of frailty (Weiner, Duncan, Chandler, & Studenski, 1992). Weiner et al. (1992) investigated FR as a marker of physical frailty compared with other clinical measures of physical performance including: Mobility Skills Protocol, Physical Activities of Daily Living, Instrumental Activities of Daily Living, 10-foot walking speed, one-footed standing, life space, and tandem walking. Their study showed elderly persons with a reach less than seven inches were limited in their mobility skills, could not perform tandem walking or one-footed stance, ambulated slowly, and were restricted in ADL's and life space (Weiner et al., 1992).

In the third phase of the FR development Duncan et al. (1992) assessed the predictive validity of FR in identifying elderly male veterans at risk for recurrent falls. Impaired balance was noted as a risk factor for falls (Campbell et al., 1989; Perlin, 1992; Reinsch et al., 1992), and an assessment measure of balance was in great demand due to the high incidence of injury resulting from elderly falls (Duncan et al., 1992). Analysis of 217 subjects revealed FR was an important predictor of falls among elderly male veterans. The researchers' results suggest a low FR score may be used as a screen to identify those at high risk for falls (Duncan et al., 1992).

Weiner et al., (1993) conducted the fourth phase of the FR development which focused on the measure's sensitivity to change in
a rehabilitation setting. The sensitivity to change for FR was 0.97 thereby implying FR was a valuable instrument to detect improvement or decline in balance over time. The researchers were, however, unable to show whether rehabilitation improves FR as a result of the many individual and external factors involved in intensive rehabilitation (Weiner et al., 1993).

The functional reach test has recently been used in a wide variety of samples such as wheelchair users, (Curtis, Kindlin, Reich & White, 1995) children, (Donahoe et al., 1994) and as a component of many other balance studies. These studies supported the effectiveness and value of the FR test (Curtis et al., 1995; Donahoe et al., 1994). Although many studies have found FR to be a valuable instrument, one study comparing clinical and biomechanical measures of mobility and balance in elderly nursing home residents found a modest test-retest intraclass correlation coefficient (ICC) of 0.57 for functional reach and the biomechanical measures. In addition, many of their subjects (19%) were unable to perform the activity. The discrepancy may have been due to the level of physical decline and health fluctuations evident in nursing home residents (Thapa et al., 1994).

The FR test does not address lateral dynamic stability, however as noted by Donahoe et al. (1994) it does reflect skill in forward weight shift, reaching and postural control, and several aspects of balance such as strength, biomechanics, proprioception, vestibular mechanisms, and motor planning. This measure is both functional and realistic because the subject initiates the movement in a feedforward manner, instead of responding to external artificial
stimuli (Donahoe et al., 1994). The FR test simulates everyday activities that challenge a person's postural stability. In summary, the FR test proved to be effective in measuring dynamic balance, cost-effective, easy to administer, reliable, sensitive to change, and predictive of fall risk.

**Timed Up and Go**

The timed Up and Go Test is a modified version of the "Get-up and Go" Test (Mathias, Nayak, & Isaacs, 1986), and both measure balance in elderly people. The creators of the original Get-Up and Go Test devised the measure because many frail people fall during functional activities such as rising from a chair, walking, turning, or attempting to sit down. During the test, the subject is asked to sit comfortably in a chair and then asked to rise, to stand still momentarily, walk 10 feet, turn, walk back to the chair, turn around, and sit down. Any deviations from a normal performance were observed and indicated a potential balance impairment. The Get-up and Go Test was graded on the following five-point qualitative scale: 1= normal; 2= very slightly abnormal; 3= mildly abnormal; 4= moderately abnormal; 5= severely abnormal. A one was awarded if the subject appeared to have no risk of falling during the performance, and a five was given if the subject showed risk of falling. The study conducted by Mathias et al. (1986) revealed a score of three or more indicated fall risk. The authors concluded the simple Get-Up and Go Test was a reliable and valid test for quantifying functional mobility, and was a quick and practical measure of balance (Mathias et al., 1986).
The timed Up and Go Test (Podsiadlo & Richardson, 1991) was developed because the original get-up and go measured the quality of the performance only, allowing variability among the examiners, therefore, creating an imprecise scoring system (Berg et al., 1992). The extremes (1 and 5) of the scale were easy to score; however, the intermediate levels (2-4) were less clear. The modified version measures the amount of time in seconds it takes the subject to perform the same tasks: rise from a chair with arm rests, walk to a line on the floor 10 feet away, turn, return, and sit down (Podsiadlo & Richardson, 1991).

Podsiadlo & Richardson (1991) performed a study to assess the usefulness of the timed Up and Go as a screen for functional mobility in frail community-dwelling elderly people. The timed Up and Go was shown to be a reliable and practical performance test of physical mobility. The test's simplicity makes it practical. The timed score makes the test objective and easy to record, and no special training is required to administer the test. The study showed independently mobile subjects generally performed the test in less than 20 seconds. Those people who required assistance for mobility tasks generally performed the test in 30 seconds or longer (Podsiadlo & Richardson, 1991). It has been shown to be reliable between raters and over time. It also has both content validity, "in that it evaluates a well recognized series of manuevers used in daily life", and concurrent validity, "in that it correlates well with more extensive measures of balance, gait speed, and functional ability" (Podsiadlo & Richardson, 1991, p. 147). The timed Up and Go can be used as a screening test.
for further assessment, or as a descriptive tool to indicate balance, gait speed, and functional capacity (Podsiadlo & Richardson, 1991).

**10-Foot Walk**

Gait in the elderly is often characterized by many changes including a decrease in speed. When compared with younger individuals, healthy older persons were shown to walk slower (Imms & Edholm, 1981; Murray, Kory, & Clarkson, 1969). Many changes in gait in the elderly can contribute to the risk of falling (Tinetti et al., 1986; Tinetti et al., 1988). Imms and Edholm (1981) showed gait was compromised and characterized by a decreased speed and shorter stride in elderly persons who fall when compared with non-fallers. A study of fallers in nursing homes showed significantly reduced walking speed (.37m/s) when compared to a control group (.64m/s) (Wolfson, Whipple, Amerman, & Tobin, 1990). Not only are gait speed and gait characteristics used in balance studies, they are often used in combination with other balance measures.

One recent study looked at clinical assessment methods as screening tests for detecting balance and mobility impairments in the elderly (Harada et al., 1995). The clinical methods included objective measures of functional balance (Berg Balance scale and Tinetti’s POMA balance subscale measures) and gait speed, and a subjective report on the fear of falling. All measures had high sensitivity and specificity for screening balance and mobility impairment in the community-dwelling elderly population. The highest sensitivity and specificity results included the combination of the Berg Balance scale and gait speed. These researchers stated this combination of
functional balance and gait had the most potential for use as a screening method, specifically for referral to physical therapy for a detailed evaluation. Functional balance and gait speed were selected because geriatric literature has established the reliability and validity of these tests. Although an insole footswitch and extensive balance measures (multiple item scales) were used in this study, the investigators suggest simpler screening tools. Examples include a stopwatch to replace the footswitch and balance measured with a one item test such as the forward reach technique (Harada et al., 1995).

Another study of functional reach (FR) as a marker of physical frailty was done to establish concurrent validity of FR to other physical performance measures such as the average walking speed for 10 feet. Functional reach and walking speed for 10 feet had a strong correlation of .71. Subjects with a low FR (<7 inches) had a mean walking speed of 1.65 feet/sec and subjects with a greater FR (>7 inches) averaged 2.72 feet/sec (Weiner et al., 1992).

A final study by Podsiadlo and Richardson (1991) developed a timed version of "get-up and go" test in 60 elderly patients. They hypothesized that "the timed 'Up and Go' score would correlate with the patient's balance, gait speed, and functional capacity" (p.143). Results from each variable supported the hypothesis suggested. Specifically, the time scored on the timed Up and Go related to gait speed ($r = -0.55$) even though a variation in speed (0.1- 1.4 m/sec) was reported (Podsiadlo & Richardson, 1991).

Both the timed Up and Go and the 10-foot walk are considered mobility performance measures, but each test involves different mobility skills. Isaacs defines "basic mobility skills as getting in and
out of bed and chair, on and off the toilet, and walking a few feet" (Isaacs, 1985). A test like the timed Up and Go represents basic mobility skills that include tasks such as standing up, walking ten feet, turning, and returning to sit down in the chair. The components of this test involve four areas of mobility maneuvers common to falling (Podsiadlo & Richardson, 1991). The 10-foot walk considers one component of a basic mobility skill. Both tests consider different components of a person's basic mobility skill required for functional maneuvers. Performance on these types of tasks have been shown to be significantly impaired in fallers compared to non-fallers (Studenski, Duncan, & Hogue, 1989). and in addition, the performance of these tasks is commonly impaired in older persons (Bohannon, 1984; Briggs et al., 1989; Heitman, 1989). Therefore, assessment of community-dwelling elderly should focus on functional mobility tasks (Tinetti, 1986).

Mini-Mental State Examination (MMSE)

The Mini-Mental State Examination (MMSE) was devised in 1973 by Folstein, Folstein, & McHugh (1975) because the available quantitative assessments of cognitive performance were too lengthy. This simplified version of cognitive mental status includes eleven questions and requires approximately 5-10 minutes to administer. The word "mini" was chosen because the MMSE focuses only on cognitive aspects of mental functions. Questions of mood, mental experiences, and the form of thinking were excluded from the MMSE (Folstein et al., 1975).
The original study, published in 1975, documented both validity and reliability when given to 206 patients including normal elderly people and samples of adults with clinical conditions like dementia. Although the MMSE is a valid test of cognitive function, it was not designed on its own to provide a diagnosis of cognitive disability. The ease of administration and widespread use of the MMSE has made this test a standard screening instrument not a diagnostic tool of cognitive function (Fleming, 1995).

In 1992, a comprehensive review of the MMSE included the properties and utility of the MMSE over the past 26 years (Tombaugh & McIntyre. 1992). The protocol for proper use of the test is described in the methodology (chapter 3) while this discussion will provide conclusions from the comprehensive review over the past 26 years. First, the MMSE is the most widely used screening test despite a substantial number of other objective measures. Second, validity was described when the MMSE was compared against other gold standards such as the DSM-III-R criteria in multiple studies. Assessment of validity was established by how well the MMSE identified normal and impaired individuals according to accepted criteria or gold standards, and correct identification of previously classified cognitively intact individuals. Next, reliability measures, such as internal consistency and test-retest reliability, were confirmed in multiple studies. The last conclusion taken from the comprehensive review related back to the objectives set by the original study. The MMSE should not be the sole criterion for cognitive diagnosis. It should be used as a screening tool with low
scores indicating a need for further evaluation (Tombaugh & McIntyre, 1992).

The conclusions from the comprehensive review were established from studies with a wide variety of subjects from cognitively intact community residents to persons with severe cognitive impairments. The wide use of adult and elderly subjects in epidemiological studies and community surveys described in the review are not the only use of the MMSE (Tombaugh & McIntyre, 1992). To determine inclusion criteria of subjects, researchers often utilize the MMSE as a screen to establish appropriate cognitive eligibility for subjects outside of cognitive research. One example is a study which used functional reach to identify recurrent falls and used a minimum score on the MMSE for eligibility. This minimum score was necessary because subjects had to give historical information and report their falls (Duncan et al., 1992). A second study looked at interventions to reduce the risk of falling for elders living in the community. Again, a minimum score was used for eligibility criteria (Tinetti et al., 1994).

These research examples require cognitive functions covered in the MMSE. Specifically, the cognitive function or domains covered by the MMSE are "orientation, registration, attention and calculation, recall, language, and visuospatial construction" (Launer, Dinkgreve, Jonker, Hooijer, & Lindeboom, 1993; Tombaugh & McIntyre, 1992). A sample question of language includes having the patient follow a three-stage command: "take the paper in your right hand. Fold the paper in half. Put the paper on the floor" (Tombaugh & McIntyre, 1992, p. 935). The completion of this task by a patient may help
indicate their ability to follow the commands used in other research tests such as functional reach. In this example the subject receives one point for each component involved in this task for a maximum score of three points on this question. Total possible points on the MMSE is 30 with separate scoring for each question. Classification of cognitive impairment is divided into three levels: 24-30 = no cognitive impairment; 18-23 = mild cognitive impairment; and 0-17 = severe cognitive impairment (Tombaugh & McIntyre, 1992).

The MMSE is not without shortcomings. The most commonly cited problem includes "its lack of sensitivity to mild cognitive impairment and its failure to adequately discriminate patients with mild AD" (Alzheimer's disease) "from normal patients" (Tombaugh & McIntyre, 1992, p. 931). Another problem with the original MMSE involved the wording in the questions of orientation. The MMSE was developed to test hospital patients and the orientation questions required respondents to describe the name and floor of their hospital. Variations in the wording of these questions are often used when the MMSE is administered to subjects outside the hospital setting. Two studies which used alternate wording for orientation questions required respondents to describe the name and floor of their hospital. Variations in the wording of these questions are often used when the MMSE is administered to subjects outside the hospital setting. Two studies which used alternate wording for orientation questions involved community surveys and epidemiological studies (Folstein, Anthony, Parhad, Duffy, & Gruenberg, 1985; O'Connor, Pollitt, Treasure, Brook, & Reiss, 1989). A comparison of the orientation questions in the original study and the alternative wording is provided below:

Original (Folstein et al., 1975, p. 196)
"Where are we: (state) (county) (town) (hospital) (floor)."

Alternative wording (Folstein et al., 1985, p. 233-234)
"Can you tell me where we are right now?"
"For instance, what state are we in?"
"What city are we in?"
"What are two main streets nearby?"
"What floor of the building are we on?"
"What is the address or what is the name of this place?"

In this question the total possible points is five with one point awarded for each correct answer (See Appendix C).

In general, the MMSE is a valid and reliable test of cognitive function, and when used according to its original objectives it is a valuable clinical screening instrument. The original study found the MMSE to be efficient, easy to administer, and acceptable to both patients and testers (Folstein et al., 1975).

Conclusion

The population of elderly women continues to grow and is placing demands on health professionals to identify more efficient assessment tools to ensure quality care, and quality of life through independent function. Although there is not a lack of tools available to assess geriatric patients, there is a lack of consistency in the use of these tools, specifically balance assessment measures. In addition, these tools should be reliable, valid, objective, cost effective, and easy to administer. The functional reach, 10-foot walk, and timed Up and Go meet these criteria and offer health professionals realistic measurements in the clinical atmosphere. The null hypothesis of this study is that no correlation will be found between the physical
performance measures functional reach, 10-foot walk, and timed Up and Go.
CHAPTER THREE

METHODOLOGY

Design and Instruments

The purpose of this study was to establish the concurrent validity of functional reach by determining the relationship between functional reach and other physical performance measures in elderly women. Grand Valley State University Human Subjects' Review Committee provided written approval for use of volunteers (Appendix A). Written approval was obtained for the recruitment of volunteers from the facility directors of senior centers (Appendix B).

Measurement tools used in this study include functional reach (FR), timed Up and Go, 10-foot walking speed, and the Mini-mental state exam (MMSE). All physical performance measures included a trained single spotter to insure the subject's safety. The functional reach measure is used to quantitate balance impairments. The timed Up and Go is a measure of the ability to rise from a chair, walk 10 feet, turn 360 degrees, and return to the chair. The final physical performance measure was the 10-foot walking speed in which the subject was timed as they walked 10 feet at their normal pace. Each of these tools provided data on functional physical performance measures.
Subject Population

Using a sample size calculation, approximately 50 volunteers were needed for this study. Forty-six subjects were recruited from four sites. Site A consisted of 18 elderly women who were involved in exercise groups. Subjects at the last three sites were elderly women who lived independently at retirement homes. There were 11 subjects at site B, 5 at site C, and 12 at site D.

Inclusion criteria for sample subjects were described by cognitive, physical, and demographic variables. Cognitive variables were determined by the Mini-Mental State Examination (MMSE) (Appendix C) with a minimum score of 24 out of 30 needed to be included in the experiment. The MMSE score helped establish the subject's ability to follow two and three step commands. Testers used phrases such as "OK" and "that's fine" after the subject's response to questions. These statements interfere the least with the results and are noncommittal phrases. Questions were asked according to the copyright form, except for the modification to question one, as stated in the literature review, and scores were taken immediately. There was no time limit with the MMSE.

The physical variables for inclusion in this study included the ability to stand unassisted by another individual for 60 seconds, to raise their arms to 90 degrees with their elbow straight, and walk 20 feet with or without an assistive device. These variables were screened at the data collection session. The pre-screen questionnaire provided inclusion criteria by asking the subject whether she can dress, bathe, and use the toilet without assistance from another
individual. A "yes" answer for all three variables was required in order to meet the eligibility criteria. Demographic variables for inclusion required female subjects to be 65 years or older. Subjects were volunteers from senior centers who met all eligibility requirements.

Investigators

The investigators were two Grand Valley State University students in their third year of the Master's degree physical therapy program. Their role was to direct the entire study, conduct the measurements of the MMSE and each physical performance test including functional reach, timed Up and Go, and 10-foot walk. The investigators supervised the safety of the subjects with a spotter provided at each station.

Investigator Training

Prior to data collection, the investigators conducted a practice session on 10 subjects to test interrater and intrarater reliability. Interrater reliability was found between the two raters on all three physical performance measures. Functional reach correlations ranged from $r = .90$ to $.99$; timed Up and Go correlations ranged from $r = .90$ to $.98$; and 10-foot walk correlations ranged from $r = .66$ to $.91$. Intrarater reliability was found for FR and timed Up and Go. Both investigators had a correlation of $r = .91$ for FR. Investigator one had a correlation of $r = .94$ and investigator two had a correlation of $r = .90$ for timed Up and Go. The 10-foot walk had questionable interrater reliability for investigator one ($r = .53$), and investigator
two was found to be $r = .81$. No changes were made to the method as a result of the practice session.

**Procedure**

A session for recruitment of volunteers was provided by each senior center director after the director consent form was signed. A time was set to meet the eligible clients at a designated area at each senior center, as well as to screen for further inclusion criteria, describe the general purpose of the research, answer any questions, complete the consent form, and collect data. Subjects were given a number to assure confidentiality. Researchers alternated collecting data on every other subject.

When the subject arrived, and the presence of inclusion criteria was established, she completed the pre-screen questionnaire and consent form (Appendix B). After the subject signed the consent form, the MMSE was given by one of the raters. Following the MMSE, the physical performance measures were performed in the following order without rest: FR, timed Up and Go, and 10-foot walking speed. Standard equipment was used at all sites for data collection.

In the study FR was measured using a standard yardstick secured to the wall at the height of the subject's acromion process of her dominant upper extremity. The subject was asked to make a fist and raise her arm parallel with the stick. An initial and final measurement were taken with alignment to their third metacarpal. Any reach strategy could be used. If during any trial the subject's feet moved, or the wall was touched data was discarded and trial repeated. Subjects
were given two practice trials, with the next three trials recorded. A mean value over the last three trials was recorded.

Subjects were given one practice trial for the timed Up and Go and the second trial was performed and the score recorded. Standard chairs with arm rests and similar dimensions were used throughout data collection. Subjects could use assistive devices as needed. A stopwatch was used to record each trial.

For the 10-foot walking measure, the floor was marked with tape at the starting point, at five feet, fifteen feet, and twenty feet. The subject walked a total of twenty feet; however, actual timing with a stopwatch began after five feet and ended at fifteen feet. This gave the subject time to accelerate and decelerate. Subjects were given one practice trial and performed one recorded trial. Subjects could use their assistive device if needed. Standardized instructions for each performance test were used by each investigator (see Appendix C).
CHAPTER 4

RESULTS

The null hypothesis of this study was that no correlation would be found between the physical performance measures functional reach, 10-foot walk, and timed Up and Go. The following chapter will discuss the approach used for statistical analysis and results from each test.

Data collection included 46 community-dwelling women aged 65-94. Subjects were recruited from four sites: site A n = 18, site B n = 11, site C n = 5 and site D n = 12. Table 1 includes raw data for the three physical performance measures including mean, standard deviation, minimum, and maximum scores. Table 2 includes scores for the physical performance tests based on age group and site categories.

Pearson correlation coefficient was utilized to analyze the relationship between FR, timed Up and Go, 10-foot walk, and age. The correlation between FR and both timed Up and Go and 10-foot walk were modest, $r = -.51$ and $r = -.53$, respectively. The association between timed Up and Go and 10-foot walk were strong, $r = .90$ (See Table 3). The relationship between FR and age was $r = -.40$ ($p =$
Table 1

**Raw Data Results on Three Physical Performance Measures (N=46)**

<table>
<thead>
<tr>
<th>Physical Performance Test</th>
<th>M</th>
<th>SD</th>
<th>MIN</th>
<th>MAX</th>
</tr>
</thead>
<tbody>
<tr>
<td>functional reach (inches)</td>
<td>9.04</td>
<td>2.71</td>
<td>4.17</td>
<td>15.00</td>
</tr>
<tr>
<td>timed Up and Go (seconds)</td>
<td>12.98</td>
<td>6.07</td>
<td>6.62</td>
<td>36.03</td>
</tr>
<tr>
<td>10-foot walk (seconds)</td>
<td>3.08</td>
<td>1.08</td>
<td>1.56</td>
<td>6.10</td>
</tr>
</tbody>
</table>
Table 2

Scores on Physical Performance Tests Based on Age Group and Site Category

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<tr>
<th></th>
<th>functional reach (inches)</th>
<th>timed Up &amp; Go (sec.)</th>
<th>10-foot walk (sec.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td><strong>Age Group</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 (65-75)</td>
<td>16</td>
<td>9.61</td>
<td>2.53</td>
</tr>
<tr>
<td>2 (76-85)</td>
<td>22</td>
<td>9.35</td>
<td>2.76</td>
</tr>
<tr>
<td>3 (&gt;86)</td>
<td>8</td>
<td>7.06</td>
<td>2.29</td>
</tr>
<tr>
<td><strong>Site Category</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>18</td>
<td>10.60</td>
<td>2.19</td>
</tr>
<tr>
<td>B</td>
<td>11</td>
<td>7.15</td>
<td>2.54</td>
</tr>
<tr>
<td>C</td>
<td>5</td>
<td>10.22</td>
<td>2.50</td>
</tr>
<tr>
<td>D</td>
<td>12</td>
<td>7.94</td>
<td>2.25</td>
</tr>
</tbody>
</table>
Table 3

Pearson Correlation Coefficients for the Functional Reach, Timed Up & Go and 10-Foot Walk (n=46)

<table>
<thead>
<tr>
<th></th>
<th>FR</th>
<th>timed Up &amp; go</th>
<th>10-foot walk</th>
</tr>
</thead>
<tbody>
<tr>
<td>timed Up &amp; Go</td>
<td><em>r = -.51</em></td>
<td>----</td>
<td></td>
</tr>
<tr>
<td>10-foot walk</td>
<td><strong>r = -.53</strong></td>
<td><em>r = .90</em></td>
<td>----</td>
</tr>
<tr>
<td>age</td>
<td>*<strong>r = -.40</strong></td>
<td><em>r = .24</em>**</td>
<td><em>r = .25</em>**</td>
</tr>
</tbody>
</table>

Note: * p < .001
** p = .006
*** p > .1
The associations of age to timed Up and Go and 10-foot walk were $r = .24$ and $r = .25$ with $p$ values greater than .10 for both.

Reaching less than 7 inches has been set as the standard of frailty or physical decline as found in current research (Weiner, Duncan, Chandler, & Studenski, 1992). In this study, the mean timed Up and Go for subjects with a FR of less than 7 inches ($n=10$) was 18.39 ($SD = 7.88$) seconds. Subjects with FR greater than 7 inches ($n=36$) was 11.47 ($SD = 4.55$) seconds. The mean 10-foot walk for subjects with less than 7 inches ($n=10$) on FR was 4.05 ($SD = 1.06$) seconds. Subjects with greater than 7 inches ($n=36$) was 2.79 ($SD = .94$) seconds.

The subjects were divided into three age groups including group 1 aged 65-75 years ($n=16$), group 2 aged 76-85 ($n=22$), and group 3 aged 86 and older ($n=8$). Pearson correlation coefficient was used to analyze the relationship between FR, timed Up and Go, and 10-foot walk within each of the three age categories. Table 4 provides the correlation coefficients for the three age groups. A trend seen in the correlation of FR and the other physical performance measures was a decrease in correlation as age increases. Timed Up and Go and 10 foot walk had similar correlations in all age categories.

In order to control for age with these associations, partial correlation coefficients were found between physical performance measures. The partial correlation coefficient between FR and timed Up and Go and 10-foot walk was $r = -.46$ and $r = -.48$, respectively ($p = .001$). The association between timed Up and Go and 10-foot walk was $r = .89$ with a $p$ value of <.001.
Table 4

**Pearson Correlation Coefficients for the Functional Reach, Timed Up & Go and 10-Foot Walk by Age Groups**

<table>
<thead>
<tr>
<th>Age Group 1 (n = 16)</th>
<th>FR</th>
<th>timed Up &amp; Go</th>
<th>10-foot walk</th>
</tr>
</thead>
<tbody>
<tr>
<td>65-75 years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>timed Up &amp; Go</td>
<td></td>
<td>$r = -0.70^{**}$</td>
<td></td>
</tr>
<tr>
<td>10-foot walk</td>
<td></td>
<td>$r = -0.72^{**}$</td>
<td>$r = 0.92^{***}$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age Group 2 (n = 22)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>76-85 years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>timed Up &amp; Go</td>
<td></td>
<td>$r = -0.47^{*}$</td>
<td></td>
</tr>
<tr>
<td>10-Foot Walk</td>
<td></td>
<td>$r = -0.45^{*}$</td>
<td>$r = 0.91^{***}$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age Group 3 (n = 8)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;86 years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>timed Up &amp; Go</td>
<td></td>
<td>$r = -0.14^{\wedge}$</td>
<td></td>
</tr>
<tr>
<td>10-Foot Walk</td>
<td></td>
<td>$r = -0.34^{\sim}$</td>
<td>$r = 0.92^{***}$</td>
</tr>
</tbody>
</table>

Note: * $p < .05$  
** $p < .01$  
*** $p < .001$  
\^ $p = 0.74$  
\~ $p = 0.41$
CHAPTER 5

DISCUSSION

Introduction

The purpose of this correlational study was to establish concurrent validity of functional reach (FR), as a measure of physical decline, by determining the relationship between FR and other physical performance measures. The goal was for health care professionals to utilize FR as a screen for elderly women. The correlations in this study were not as strong as in the pilot studies performed by Weiner, Duncan, Chandler, & Studenski (1992), who studied FR as a marker of physical frailty in men and women.

Discussion of results

From the literature review, a FR score of less than 7 inches indicates physical frailty or decline (Weiner et al., 1992). The mean FR for all subjects in the study was greater than 7 inches. Subjects grouped by site and age categories each had a mean FR greater than 7 inches. A general trend from the raw data results showed as age increases FR decreases (see Table 2). This trend was also noted in a study on FR conducted by Duncan et al. (1990). As age increased, in this study, performance on both timed Up and Go and 10-foot walk declined, which was shown by increased timed scores. Weiner et al.
(1992) did report correlations of FR to other physical performance measures, but did not correlate the other measures to each other.

Correlation coefficients was the statistic used to measure concurrent validity of the FR test and other physical performance measures. FR showed a modest correlation with both timed Up and Go ($r = -.51$) and 10-foot walk ($r = -.53$). In previous studies correlation figures were consistently above $r = .60$ (Weiner et al., 1992). Therefore, our results were below the previously reported FR correlations. For example, Weiner et al. (1992), found the correlation to be $r = .71$ between FR and walking speed for 10 feet.

Past studies of FR performed on elderly men and women showed high correlations between FR and other physical performance measures (Weiner et al., 1992). This study performed only with elderly women did not show as high a correlation of FR with other physical performance measures. Perhaps this discrepancy results from a different sample. Weiner et al. (1992) obtained their sample from hospital clinics, whereas this study recruited a more diverse sample, which may be more representative of community-dwelling elderly women. The 46 volunteers from this study represented both urban and rural communities. They also demonstrated a wide variety of functional capabilities. For example, site A subjects were recruited from an elderly exercise class, and the volunteers from the other three sites were residents in retirement centers who appeared to live more sedentary lifestyles.

Another possible explanation as to why correlation results were low may be due to confusing instructions given for the FR. Evidence of their confusion was reflected in the three individual scores taken
for each subject on the FR test. Twenty of the forty-six subjects had a
2-inch or more difference across their three FR trials. One example
includes an 69 year old female who had three reaches in the following
order: 14.5, 10.0 and 10.25 inches. This shows a four-inch
difference between her best and worst FR score.

Further evidence of inconsistency was apparent in the scores of
the practice session subjects. Approximately half of the subjects used
to test inter- and intrarater reliability also had a 2-inch or more
difference across three trials. When considering that physical frailty
is defined by a FR of less than 7 inches (Weiner et al., 1992), a 2-inch
difference between scores may falsely label an individual as frail or
may miss identifying someone who is at risk for physical decline.
Both practice session subjects and elderly women subjects may have
not performed up to their potential due to the wording of the
instructions. Subjects demonstrated a wide variety of responses to
the instructions, therefore, it was difficult to determine which section
of the instructions was problematic.

Despite modest correlations with FR, 10-foot walk and timed
Up and Go correlated strongly ($r = .89$). A high correlation was
expected between these two because they each test similar functional
skills. These skills are automatic and performed repeatedly
throughout the day. The FR test is not a practiced movement for
most subjects. In addition, most reaching tasks are not performed in a
straight forward horizontal plane but in a diagonal plane.

Functional reach was modestly correlated to subject age
($r = -.40$). Therefore, as an elderly woman ages her FR score
declines. This result was expected because generally a person
becomes less physically active and has more health problems. With increased age she is more likely to score poorly on physical performance measures due to multiple factors often associated with the aging process (Lewis, 1996).

Correlations among age groups showed different results than those of the whole sample (Table 4). The association between FR and timed Up and Go and 10-foot walk decreased as age increased. This indicates more variability in the older age categories. In the 65-75 age group a strong correlation was found between FR and 10-foot walk ($r = -.72$). This correlation decreased in the 75-85 age group ($r = -.45$), and remained low in the oldest age group ($r = -.34$). This trend was also evident in the correlation between FR and timed Up and Go: $r = -.70$ in group 1, $r = -.47$ in group 2, and $r = -.14$ in group 3. The low correlations in the oldest age group may represent the increased complexity of the aging woman. This may indicate the need for multiple screening tools for all age groups, but especially for women 86 and older.

In reference to this study, the trend of decreasing correlations as age increases may reflect the unequal number of subjects in each age group. Specifically, the third age group (>86 years) had only 8 of the total 46 subjects. The correlation of FR and 10-foot walk and timed Up and Go in the 75-85 age group ($r = -.45$ and -.47, respectively) reflects results found in the overall FR correlation coefficients for the entire sample (10-foot walk $r = -.53$ and timed Up and Go $r = -.51$). This result could be due to the large number of subjects in the 75-85 age group ($n = 22$).
The trend of decreasing correlations across age groups seen with FR was not demonstrated in the relationship between the other physical performance measures across age groups. The 10-foot walk and the timed Up and Go had high correlations throughout all three age groups. Past research has not analyzed their data by age groups. This trend confirms the concurrent validity of FR in the 65-75 age group. However, the results indicated weak concurrent validity for FR in the older age groups (76-85 years and >86 years).

The effects of age were taken out using partial correlations. A modest clinical significance was found between FR and 10-foot walk along with FR and timed Up and Go ($r = -.48$ and $r = -.46$ respectively). Timed Up and Go and 10-foot walk correlated significantly with each other ($r = .89$).

**Clinical Application**

Overall, this study did not find strong correlations between FR and other physical performance measures. Although strong correlations were not found, FR has clinical value and may have increased value when used in conjunction with other screening tools. The results of this study are important because they differ from the results of previous research performed on the FR.

Administration of the FR test during data collection raised questions of its efficacy. First, questions arose as to whether or not the FR was a truly objective measure. For example, many subjects had a 2-inch or more difference in FR scores across three trials thereby showing difficulty understanding instructions. Although the
MMSE concluded all subjects were cognitively intact, subjects struggled with both following instructions and demonstrations.

Often, performance was not optimal due to improper hand position, maintained shoulder protraction between trials, and reaching in line with the yardstick. Both alignment of hand position to the yardstick and a lack in the ability to hold a steady position interfered with objective collection of the data. Although efforts were made to correct for improper positioning, subjects continued to have difficulty. For example, an 87 year old subject scored 10.5, 10.0 and 5.5 inches. Observation indicated improper positioning due to maintained shoulder protraction after the first trial. Her start positions for trials 2 and 3 were four inches in front of her first trial. Therefore, shoulder protraction led to a decreased score because the initial measurement was closer to the final measurement. As a result of all of the improper positions, scores on the FR may have been below the subjects' potential.

Despite the questions that evolved from this study, the FR may provide more insight about the functional level of a patient than of the medical issues. Based on the Pearson correlation coefficients and partial correlation coefficients, the results from this study conclude the FR is a clinically significant tool for the young elderly (65-75 years) but does not represent the standard in measuring balance across all age groups.

Timed Up and Go and 10-foot walk were found to be highly correlated and effective tools because of their ease in administration, clear instructions, and both were quantifiable. In general, performance on these two tests appeared to be closer to the subjects'
potential than the FR test. Specifically, the timed Up and Go seemed to simulate daily activities especially those skills closely related to falls. These skills include standing up, walking, turning, and sitting down. As a result of this study's strong positive correlation between timed Up and Go and 10-foot walk ($r = .90$), utilizing both measures on the same patient may be redundant because they test similar skills.

Limitations

The limitations of this study are centered around the subjects. All subjects were volunteers and may have limited the variability in subject population. Therefore, we are unsure if these subjects represent a true sample of the elderly female population. The four sites had unequal numbers of subjects and an unequal distribution in the three age categories. Although all subjects represented community-dwelling individuals, one site differed from the other three sites. This site included subjects involved in exercise groups and none of these volunteers resided at this facility. The subjects from the other three sites had relatively similar characteristics and all lived in the facilities. A final limitation involving the sample was the lack of uniformity in following instructions and performance of the FR. Again, this could contribute to a skewing in the results.

Another limitation of this study was the objectivity of the FR. Other researchers have found the FR to be objective (Weiner et al., 1991), but the researchers in this study found it difficult to obtain an objective measurement. Again variations in hand position and other variables previously discussed create questionable results.
A third limitation was that various pathological conditions were not controlled for in the study, therefore, there is no way to account for these variables and their effect on the physical performance tests scores. An example from this study is a subject who performed the FR with her nondominant hand due to the effects of a previous stroke on her dominant upper extremity. This subject may have had a lower score on the FR test because she was not as agile with the nondominant hand, and not due to poor balance.

A final limitation is the researcher inexperience in administering the FR. Instructions of the FR test could have been more precise to ensure subject comprehension. Despite the above limitations, this study's results indicate a modest clinical significance of concurrent validity across physical performance tests. These physical performance tests may be used as screens in determining physical decline in elderly women.

**Further Research**

Numerous studies on balance and physical decline have been conducted on men and women, but research focusing solely on women is limited. Future research is needed on women, both young and old. Other studies of FR could focus on different levels of functioning in elderly women. The results of this study question the conclusions of previous research, and warrant a need for further studies on the concurrent validity of FR, especially across age groups of equal numbers. Research is needed to determine how to eliminate the wide variability across FR trials. Normative values for lateral reaching or a modified sitting FR could also be valuable. In addition,
other reaching performance measures should be explored. These measures should then be correlated with FR.

**Conclusion**

The purpose of this study was to establish concurrent validity between FR and other physical performance measures in elderly women. The results indicate that concurrent validity is strong in elderly women aged 65-75 years, but is modestly correlated in elderly women aged 76-85 years. Weak correlations were evident in the oldest age group of >86 years. The declining correlations show that FR, the timed Up and Go, and the 10-foot walk may not test similar skills in women 86 years and over when compared to younger elderly women (65-75 years). When considering all elderly women subjects, correlations of the FR to the other physical performance measures were modest. These findings question the concurrent validity established by previous researchers and indicate a need for additional research on the concurrent validity of the FR.
References


impairment in elderly individuals living in residential care facilities. *Physical Therapy.* 75 (6), 462-469.


Please Note

Page(s) not included with original material and unavailable from author or university. Filmed as received.

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UMI
APPENDIX A

Consent Forms and Pre-Screen Assessment
Facility Director Agreement Form

I understand this is a study of the functional reach test among elderly women living in independent community settings. The knowledge gained is expected to help physical therapists and physicians determine the usefulness of the functional reach test as a component of comprehensive geriatric assessment.

I also understand:

1. Participants in this study will perform the following tests: Mini-mental State examination, functional reach, 10-foot walking speed, and timed Up and Go.

2. This facility was chosen for its access to elderly women over 65 years old who live in independent settings.

3. Independent living includes independence in bathing, toileting, and dressing without physical assistance from another person.

4. The facility will help direct the authors in using a pre-screen assessment form to determine subject qualification.

5. The volunteers will be recruited at a facility function, and at that time the study will be discussed, and volunteers can make an appointment to participate in the research project.

6. The collection of data on the specified date at the facility should take approximately 30-45 minutes per subject with two test areas being implemented.

7. The data collected will be gathered in a safe and efficient manner, with strict confidentiality.

8. All meetings involving this study will not interfere with other activities provided by the facility.
I acknowledge:

"I have been given an opportunity to ask questions regarding this research study, and these questions have been answered to my satisfaction."

"I have been given the phone numbers of the authors, and can contact them as needed if any questions should arise."

"In giving my consent, I understand the participation in this study is voluntary, and the facility may withdraw at any time by notifying the authors."

"I have read and understand the above information, and I agree to allow this facility to be a site for subject participation in this study."

_________________________            _________________________
Director's Name            Witness

_________________________            _________________________
Director's Signature        Date

_________________________
Facility Name

_________________________
Date

Researcher: Aimee Hosek (616) 261-3051
Researcher: Kim Sackett (616) 458-4269
GVSU Committee Chairperson: Barbara Baker (616) 895-2276
Human Subjects Review Committee: Paul Heizenga (616) 895-2472
Consent Form

I understand this is a study of the functional reach test among elderly women living in independent community settings. The knowledge gained is expected to help physical therapists and physicians determine the usefulness of the functional reach test as a component of comprehensive geriatric assessment.

I also understand:

1. participation in this study will involve measurements of Mini-mental State examination, functional reach, 10-foot walking speed, and timed Up and Go.

2. I have been selected for participation because I am a female 65 years or older and live in an independent setting.

3. it is not anticipated this study will lead to any physical or emotional risk to myself.

4. the information I provide will be kept strictly confidential and the data will be coded so identification of individual participants will not be possible.

5. The investigators, Aimee Hosek and Kim Sackett, have my permission to ask me questions regarding my medical background.

I acknowledge:

"I have been given an opportunity to ask questions regarding this research study, and these questions have been answered to my satisfaction."

"I have been given the phone numbers of Aimee Hosek, Kim Sackett, Barbara Baker, and Paul Heizenga in case I have any questions regarding the study."
"In giving my consent, I understand my participation in this study is voluntary, and I may withdraw at any time by notifying Aimee Hosek or Kim Sackett."

"I hereby authorize the investigators to release the information obtained in this study to scientific literature. I understand I will not be identified by name."

"I acknowledge I have read and understand the above information, and I agree to participate in this study.

________________________________________________________________________
Participant Name                                                Witness

________________________________________________________________________
Participant Signature                                             Date

Date

Researcher: Aimee Hosek (616) 261-3051
Researcher: Kim Sackett (616) 458-4269
GVSU Committee Chairperson: Barbara Baker (616) 895-2276
Human Subjects Review Committee: Paul Heizenga (616) 895-2472
**Pre-Screen Assessment**

**Birthdate**__________ **Sex**_____ **R** or **L** handed (please circle)

**ANSWER THE FOLLOWING QUESTIONS BY CIRCLING THE CORRECT ANSWER:**

<table>
<thead>
<tr>
<th>Do you have a history of:</th>
<th>If yes, list year of diagnosis:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Diabetes</td>
<td>yes no</td>
</tr>
<tr>
<td>2. Heart disease</td>
<td>yes no</td>
</tr>
<tr>
<td>3. Arthritis</td>
<td>yes no</td>
</tr>
<tr>
<td>4. High blood pressure</td>
<td>yes no</td>
</tr>
<tr>
<td>5. Stroke</td>
<td>yes no</td>
</tr>
<tr>
<td>6. Lung problems</td>
<td>yes no</td>
</tr>
<tr>
<td>7. Cancer</td>
<td>yes no</td>
</tr>
<tr>
<td>8. Other</td>
<td>yes no</td>
</tr>
</tbody>
</table>

List all surgical procedures:

______________________________

______________________________

______________________________

**Do you wear glasses or contacts?** yes no

**Do you wear a hearing aid?** yes no

**Do you use an assistive device with walking?** (ie. cane) yes no

**Are able to dress, bathe, and use the toilet without assistance from another individual?** yes no

**Have you fallen in the past 12 months?** yes no

**If "yes" how many times?** _____
APPENDIX B

Physical Performance Measures and Mini-Mental State Examination Forms
**Functional Reach Evaluation Form**

FR measures the maximal distance, in inches, an individual can reach forward beyond arm's length while standing and maintaining a fixed base of support. Reach strategy is not otherwise controlled for.

**Instructions:**
Reach as far as you can without taking a step with your arm at the same height as the yardstick without touching the wall. Hold the position until the measurement has been recorded. Reach with dominant hand.

Practice trial #1 ___ (check)  
Practice trial #2 ___ (check)  

<table>
<thead>
<tr>
<th></th>
<th>Start position</th>
<th>Finish position</th>
<th>Distance reached</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trial #1</td>
<td>____ in.</td>
<td>____ in.</td>
<td>____ in.</td>
</tr>
<tr>
<td>Trial #2</td>
<td>____ in.</td>
<td>____ in.</td>
<td>____ in.</td>
</tr>
<tr>
<td>Trial #3</td>
<td>____ in.</td>
<td>____ in.</td>
<td>____ in.</td>
</tr>
</tbody>
</table>

**Comments/Complications:**
Timed Up & Go Evaluation Form

Timed Up and Go measures in seconds, the time taken by an individual to stand up from a standard arm chair, walk 10 feet, turn, walk back to the chair, and sit down.

Instructions:
Start with your back against the chair, and arms resting on the arm rests. If you have a walking aid you may use it. On the word "go" get up and walk at a comfortable and safe pace to the line on the floor, turn, return to the chair, and sit back down. You may walk through the test once before being timed in order to become familiar with the task.

Practice trial ___ (check)

Trial one _____ seconds

Comments/Complications:
10-Foot Walk Evaluation Form

10-foot walk measures in seconds, the time taken by an individual to walk 10 feet.

Instructions:
Start with your feet on the first tape line. On the word "go" walk at a comfortable and safe pace to the last line. You may walk through the test once before being timed in order to become familiar with the task.

Practice trial ___ (check)

Trial one _____ seconds

Comments/Complications:
Mini-Mental State Examination

Alternate wording will be used in Question #1:

Can you tell me where we are right now?
For instance:
What state are we in? (1)
What City are we in? (1)
What are two main streets nearby? (1)
What floor of the building are we on? (1)
What is the address or what is the name of this place? (1)

* One (1) point is given for each question answered correctly for a total of 5 points possible in Question #1.
NOTE TO USERS

The original document received by UMI contained pages with indistinct print. Pages were filmed as received.

This reproduction is the best copy available.
Mini-Mental State Exam

Orientation:
What is the (year) (season) (date)?
Score: 5

• Date: (year) (season) (date)
Score: 5

Registration:
Name three objects (bed, apple, shoe). Ask the patient to repeat them.
Score: 3

Attention and Calculation:
Count backwards by 7s. Start with 100. Stop after 5 calculations.
Score: .5

Alternate question:
Spell the word “world” backwards.
Score: 5

Recall:
Ask for the three objects used in question 2 to be repeated.
Score: 3

Language:
1. Naming: Name this object. (watch, pencil)
Score: 2

2. Repetition: Repeat the following—“No ifs, ands or buts.”
Score: 1

3. Follow a 3-stage command: “Take the paper in your right hand, fold it in half, and put it on the floor.”
Score: 3

4. Reading: Read and obey the following: Close your eyes.
Score: 1

5. Writing: Write a sentence.
Score: 1

6. Copying: Copy this design.
Score: 1

Total Score:________

Code #____

Instructions

Ask the date. Then proceed to ask other parts of the question. One point for each correct segment of the question.

Ask for the facility then proceed to parts of the question. One point for each correct segment of the question.

Name the objects slowly, one second for each. Ask him to repeat. Score by the number he is able to recall. Take time here for him to learn the series of objects, up to 6 trials, to use later for the memory test.

Score the total number correct.

(93, 86, 79, 72, 65)

Score the number of letters in correct order. (dirow = 5, dilorw = 3)

Score one point for each correct answer. (bed, apple, shoe)

Hold the object. Ask patient to name it. Score one point for each correct answer.

Allow one trial only. Score one point for correct answer.

Use a blank sheet of paper. Score one point for each part correctly executed.

Instruction should be printed on a page. Allow patient to read it. Score by a correct response.

Provide paper and pencil. Allow patient to write any sentence. It must contain a noun, verb, and an adjective.

All 10 angles must be present. Figures must instead. Tremor and rotation are ignored.

Max. 20. Test is not timed.