AEROBIC TRAINING TO ABATE FUNCTIONAL DEPENDENCY

by

TRUDY LATRICE MOORE

(Under the Direction of M. Elaine Cress)

ABSTRACT

With longevity steadily increasing, researchers are focusing on quality as well as quantity of life. Functional assessment is an important outcome for determining the effectiveness of interventions for improving quality of life in older adults. The purpose of the first study was to examine disability and the relationships of some commonly used physical function measures with established benchmarks for identifying risk of disability. Twenty-six older adults were assessed using the Continuous Scale Physical Functional Performance 10 item test (CS-PFP 10), Physical Performance Test, Short Physical Performance Battery (SPPB), and the Medical Outcomes Study Short Form Health Survey Physical Function subscale (SF36PF). Eighty-eight percent of the participants were at risk for preclinical disability of which 50% were at risk for moderate disability. The performance-based physical function measures were correlated ($p<0.05$) with each other, however the SF36PF was only correlated with the CS-PFP 10 ($p<0.05$). Participant's preclinical disability status was identified by a mis-match between self-report and performance-based function, where self-report was greater than performance-based. These individuals could benefit from physical activity programs to improve physical function.

Older adults, with low socioeconomic status and low physical reserves are at disproportional higher risk for chronic disease burden, functional limitations and disability. Physical activity is an effective nonpharmacological intervention for improving physiological capacity, quality of life, and physical function. The purpose of the second study was to investigate the effects of a walking intervention and nutrition education intervention on functional performance with a randomized controlled trial of low socioeconomic older adults. Twenty-four volunteers were randomized into either a walking exercise group or a control group. The walking exercise group participated in a 16-week walking program and the control group attended nutrition education presentations. The walking exercise group improved in physical function by 25% as evaluated with the CS-PFP 10 and peak aerobic capacity by 18.9%. This study, one of few that include older adults with low socioeconomic status indicates that walking, a simple exercise that can be done without specialized exercise leader or equipment significantly increases peak aerobic capacity and physical function in just four months.

INDEX WORDS: Low Socioeconomic Status, Older Adults, Physical Function, Aerobic Capacity,

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DEDICATION

This dissertation is dedicated to my sister, Janella M. Moore. Where there is love and inspiration, all things are possible.

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CHAPTER 1

INTRODUCTION

The population of adults age 65 years and older is the most rapidly growing segment of the United States. Older adults totaled 35.6 million in the year 2002 and represented approximately 12.3% of the overall population of the United States. These numbers are projected to reach 71.5 million and represent 20% of the population in 2030 (United States Department of Health and Human Services (USDHHS), 2003). This rapid increase in older adults will influence factors such as the prevalence of chronic disease and all-cause mortality and morbidity (Schneider & Guralnik, 1990). As the population ages and becomes more dependent, the impact on society, health and the public health system could be overwhelming (Blair, 1993). Physical inactivity accounts for about 2.4% of the health care costs of the United States or approximately $24 billion a year (Colditz, 1999). Direct medical costs attributable to inactivity and obesity accounted for nearly 10% of all health care expenditures in the United States (National Center for Health Statistics (NCHS), 1999). Data from the 2005 Behavioral Risk Factor Surveillance System indicated that only 42% of Georgians 65 years or older participated in at least 30 minutes of moderate physical activity five or more days a week (CDC, 2005). Participation in a regular physical exercise program and walking program is lowest among older adults with less than eight years of education and among African Americans (Clark, 1995). The Healthy People 2000 reported that more than two out of every five older adults lead a sedentary lifestyle (Public Health Service, 1990). Older adults are the greatest consumers of health care and those with low socioeconomic status are the most inactive and have the most comorbidity (Howard et al., 2000).

One of the two overall national health objectives for 2010 is to eliminate health disparities among different segments of the U.S. population (USDHHS, 2000) and older adults with lower socioeconomic status are considered one of these segments. In 2003, the median income reported for older adults over the age of 65 was $14,664 and 10.2% were below the poverty level (DeNavas-Walt, Proctor, & Lee, 2005) of $8980 (USDHHS, 2003). These older adults have a greater risk of chronic disease burden, functional limitations, and disability (Lantz et al., 2001) due to poor health and lifestyles that occur more frequently among individuals of low socioeconomic status (Reijneveld, 1998). Poor health conditions in older adults can lead to decreases in physical function, which is the ability to perform tasks required for independent living (Buchner & deLateur, 1991). Over 4.5 million older adults reported having difficulty in carrying out activities of daily living (ADLs) such as bathing, dressing, and eating, and 6.9 million reported difficulties with instrumental activities of daily living (IADLs) such as housework, money management, and taking medications (USDHHS, 2003). Physical function in activities of daily living tasks has been shown to be a strong predictor of mortality, long-term institutionalization or dependence (Stuck, Siu, Wieland, Adams, & Rubenstein, 1993). For many older adults, any reduction in performance of ADLs has a greater impact on the preservation of independence than chronic diseases from which these reductions originated (Ensrud et al., 1994). In addition to its importance in maintaining independence, reductions in activities of daily living are predictors of clinical outcomes, including need for professional home care, length of hospital stay, nursing home placement, and mortality (Frederiks, te Wierik, Visser, Sturmans, 1990).

Physical activity is an effective intervention not only for preservation of physical function in to the last decades of life, but also for the enhancement of quality of life (Ades et al., 2003, Binder et al., 2002, Cress et al., 1999). Physical activity can improve health and physical function in older adults, therefore leading to healthier independent lifestyles (Mazzeo et al., 1998). Evidence supports a positive relationship between physical activity and higher function for activities of daily living and instrumental activities of daily living (Seeman et al., 1995). Medium levels of energy expenditure may be sufficient to maintain physical function in older adults with and without chronic diseases (Young, Masaki, & Curb, 1995). Strength training has been the most studied modality for improvement of physical function (Ades et al., 2003, Brochu et al., 2002, Ettinger et al., 1997, Fiatarone et al., 1994). Fewer studies have investigated the effect of aerobic training on improving physical function. The specific aims of this study were to evaluate several functional assessment measures and a walking intervention in older adults with low income and low education.

Specific Aims

1. To compare self-reported physical function and measured physical function performance in lower socioeconomic older adults.
2. To compare the effects of a walking intervention and a nutrition education intervention on peak aerobic capacity and physical function in lower socioeconomic older adults.

Statement of Purpose

Older adults, with low income, low education, and low physical reserves are at disproportional higher risk for disability from chronic disease. Exercise has proven beneficial effects; however these populations are under-represented in the scientific literature. Moderate levels of physical activity have health benefits for all individuals; however, benefits to physical function are more effectively demonstrated in individuals at risk for institutionalization and with limited function determined by a score of less than 10 on the Short Physical Performance Battery and/or a score of less than 57 on the Continuous Scale Physical Functional Performance 10 item test. Therefore, in this study the following hypotheses will be tested.

Hypotheses

1. Self-report and performance-based physical function measures will correlate with each other.
2. Older adults sampled from a low income, low education population will be at risk for preclinical disability.
3. Physical functional performance will increase significantly in a group randomly assigned to a 16-week walking intervention as compared to a nutrition education intervention.

Significance of the Study

Since the older adult population is the most rapidly growing segment of the US population, researchers are focusing on quality as well as quantity of life (Guralnik & LaCroix, 1992). The significance of this study is that it promotes the two overall goals of Healthy People 2010, which are to 1) increase quality of life and years of healthy life and 2) eliminate health disparities (USDHHS, 2000). Quality of life of an older adult is more dependent on the level of functioning than on specific disease processes (Guralnik, Branch, Cummings, & Curb 1989), with the level of functioning making the difference between independence and dependence. This study addresses the impact of improving and maintaining functional capacity in lower socioeconomic older adults using lifestyle intervention strategies. Walking and nutrition education programs should be a major focus in the older adult community due to the potential of enhancing functional capacity. The older adult population, and specifically those with lower socioeconomic status, are the most inactive, and therefore are at greatest need for effective physical activity programming. Physical inactivity is more prevalent among women, minorities, older adults, and the less affluent (USDHHS, 2000). This study addresses the ability to implement a community-based physical activity program and adds to the literature on the understanding of the effect walking and nutrition education has on physical function in the older adult population with low socioeconomic status.

Limitations of the Study

Limitations to this study include small sample size and assessors were not blinded to the group assignment therefore, these results may not apply to all older adult populations.

CHAPTER 2

REVIEW OF LITERATURE

This chapter reviews information on physical activity, physical function, aerobic capacity, physical reserve, and the effects of exercise training on physical function and aerobic capacity. The research demonstrates the need for interventions to reduce the risk of dependence in older adults.

Physical Activity

With the advancing age of the population, there is a major need to enhance the quality of life. Increasing physical activity is one of the most feasible interventions. Non-pharmacological interventions may be the most efficacious for older people due to the economic burden and side effects of drug therapy (Sowers, 1987). Physical activity has been identified as a modifiable behavioral risk factor relating to health and quality of life among older adults (Heckler, 1985). Physical activity is defined as any bodily movement produced by skeletal muscle that results in energy expenditure (Caspersen et al., 1985). Scientific evidence increasingly indicates that physical activity offers one of the greatest opportunities to extend years of active independent life, reduce disability, and improve quality of life for older persons as well (National Blueprint, 2002).

Physical activity can produce physical and psychological benefits. Regular physical activity can improve health in the following ways: 1) reduce the risk of dying prematurely, 2) help control weight, 3) help control blood pressure, 4) reduce the risk for dying from cardiovascular disease, 5) help control blood cholesterol levels, 6) decrease the risk of developing diabetes, 7) decrease feelings of anxiety and depression, 8) decrease the risk of colon cancer, 9) help maintain healthy bones and muscle, 10) improve the use of oxygen, 11) improve mental alertness, 12) reduce isolation and 13) increase vitality (WHO, 2002). The American College of Sports Medicine recommends a regular physical activity program to elicit changes in the cardiovascular system, and changes in certain cardiovascular-disease risk factors that run counter to deteriorations normally associated with aging (Pate et al., 1995). Participation in regular physical activity elicits a number of favorable responses that contribute to healthy aging (Mazzeo et al., 1998).

The consequences of physical inactivity result in serious public health problems. The older adult population are the most inactive and at the greatest risk for chronic disease. Research has shown that only 10% of the older adult population adheres to the ACSM and CDC recommended exercise guidelines (Kushi, et al., 1997& Pahor et al., 1994). Approximately $84 million was spent annually by Medicare and Medicaid programs on chronic diseases which could have been prevented or improved by physical activity (USDHHS, 2002).

There are many factors that can prevent older adults from participating in physical activity, but there are just as many ways to overcome those factors. Communication can prevent older adults from understanding the critical importance of physical activity. Information delivered through culturally appropriate education programs can provide the tools for all older adults to take charge of their health and learn about effective lifestyle modifications. Since some older adults feel that they cannot reverse their years of inactivity, health providers need to encourage more physical activity. Fewer than 50% of older adults report that they have ever received a suggestion to exercise from their physicians (Damush, 1999). Positive support encourages older adults to participate in physical activity since 20% of older adult believe they are "too old to exercise" (Cohen-Mansfield, Marx, & Guralnik, 2003). Older adults are afraid that physical activity will increase their risk for falls but research has demonstrated that physical activity decreases the risk of falls and improves bone density (Wolf et al., 1996). Physical activity does not have to be strenuous to be beneficial; people of all ages benefit from participating in regular, moderate-intensity physical activity, such as 30 minutes of brisk walking five or more times a week (ACSM, 2001). Older adults can increase their physical activity by taking the stairs and not the elevator. Physical activity must be become a part of daily routines to improve quality of life.

Physical Function

Physical function is a key component of independent living. Physiological capacities and physical performance mediated by psychosocial factors determine physical function (Cress et al., 1996). The quality of life of an older adult is more dependent on his or her level of functioning and ability to remain independent than by specific diseases (Guralnik, Branch, Cummings, & Curb, 1989). There are numerous assessments of physical function ranging from single- to multi-items of performance-based and self-report. Moderate relationships have been found between performance-based and self-report measures of physical function (Sherman & Reuben, 1998). The Medical Outcomes Study (SF36PF) self-reported health survey physical function domain is highly correlated with performance-based tests (Cress et al., 1996). Self-reported assessments may provide supplemental information that may not be obtained through observation and performance-based may provide assessments that can not be obtained subjectively (NIA, 1993).

Researchers have developed several reliable and valid physical function assessments that measure physical function in older adults with a broad range of abilities (Cress et al., 1996, Guralnik et al., 1994 & Reuben et al., 1990). Performance-based tests such as the Physical Performance Test (PPT) (Reuben et al., 1990) and the Short Physical Performance Battery (SPPB) (Guralnik et al., 1994) are predictive of disability. The PPT is a nine-item test that is used to assess multiple aspects of daily living. A PPT score of 15-to-18 is predictive of death or institutionalization in older adults (Reuben et al., 1992). The SPPB is used to assess mobility. From epidemiological studies a score of 4-to-6 on the SPPB is predictive of higher risk of nursing home admission, incident disability, and mortality (Guralnik et al., 1995, Guralnik et al., 2000). The Continuous Scale Physical Functional Performance (CS-PFP) test is comprised of 16 household tasks performed sequentially where time, distance and weight are used to evaluate functional ability. The CS-PFP can be used to predict the probability of independence (Cress et al., 1996). A threshold of 57 on the CS-PFP and a peak oxygen consumption of 20 $ml \cdot kg^{-1} \cdot min^{-1}$ are predictive of independent living status in older adults (Cress & Meyer, 2003).

Disability

Disability is the reduction in the relationship between an individual and the environment due to the social effects of a physical or mental impairment (Verbrugge & Jette, 1994). A single catastrophic event can cause an individual to become disabled (Campbell & Buchner, 1997). The prevention of disability is a top priority for the older adult population (Lonergan, 1991). Disability is related to quality of life, mortality, health care needs, and institutionalization (Guralnik et al., 1996). Risk factors for risk of disability are age (60 and older), being female, race (African American), income (≤$20,000 a year) and fewer years of education (Guralnik et al., 1993; House et al., 1994; LaCroix et al., 1993; Stuck et al., 1999; Melzer et al., 2001). Lilienfeld & Lilienfeld, 1980 stated that there is a preclinical or subclinical state of disability characterized by early functional limitations that may not be apparent (Fried et al, 1991).

Preclinical disability is defined as early functional loss before the recognition of difficulty performing tasks (Fried et al, 1991). This operationalized definition can be used to identify individuals at risk of preclinical disability using performance-based and self-report physical function measures. The CS-PFP is one measure of preclinical disability using a score of <57 (55-58) (Cress & Meyers, 2003).

Physical Reserve

Advancing age, sedentary lifestyle, and chronic diseases are associated with decreases in aerobic capacity (Young, 1986). A decline in aerobic capacity causes an individual to work at a higher percentage of their maximum capacity during activities (Young, 1986), thus limiting the ability to complete certain activities of daily living. Physical function and measures of physiological capacity such as, maximal oxygen consumption are curvilinearly related to each other (Buchner & deLateur, 1991). A threshold was conceptualized as the bend in the curve, above which the slope of the relationship of physiological capacity and physical function is closer to zero and below which the relationship is closer to one. Using a piecewise regression and data from 196 ambulatory older adults who had performed the CS-PFP test, threshold and confidence intervals were identified. The threshold of 20 $ml \cdot kg^{-1} \cdot min^{-1}$ (95% CI= 17.33, 22.92) was identified for peak oxygen consumption and that threshold was associated with a CS-PFP score of 55.3 (95% CI = 47.8, 56.2). Below the threshold, the slope in the line indicates that one unit change in peak oxygen consumption was associated with an eight-fold greater change in CS-PFP score (Cress & Meyer, 2003). Above the threshold, the slope of the line indicated that for each unit change in peak oxygen consumption the change in CS-PFP scores was less than one unit (Cress & Meyer, 2003). These data were gathered in research from a cross sectional study design and the concepts have not been tested with a longitudinal research design. While factors other than aerobic capacity, such as mental health, strength, flexibility and balance may also factor into the change in physical function the extent to which a moderate intensity aerobic training program can change physical function in those with low or high peak oxygen consumption (VO_{2peak}) is not fully understood.

The concept of physical reserve has been posited as an older adult's physiologic capacity in excess of that required for the performance of activities of daily living (Buchner & deLateur, 1991). Older adults who lack a physical reserve are at the greatest risk of losing their ability to live independently and have the greatest need to preserve or increase their physical function and aerobic capacity. Using the CS-PFP threshold of 57 an individual with a total CS-PFP score of 30 will have a 40% chance of remaining independent (Cress & Meyer, 2003). On the other hand, a person with an aerobic capacity above 20 $ml \cdot kg^{-1} \cdot min^{-1}$ and a CS-PFP score of 70 will have a 90% chance of being independent. While both individuals can increase their aerobic capacity through an exercise program, the person below the threshold will increase his or her physical function more than the person above the threshold who will boost his or her physical reserve.

Oxygen consumption declines approximately 1% per year after the third decade of life (Astrand, 1960). Healthy sedentary adults aged 75 - 80 may have VO_{2peak} values ranging from 18 - 30 $ml \cdot kg^{-1} \cdot min^{-1}$ (Kohrt & Holloszy, 1995). The average aerobic capacity for sedentary women over the age of 60 years is 22.4±1.2 $ml \cdot kg^{-1} \cdot min^{-1}$ (Tanaka et al., 1997). The aerobic capacity that has been posited as that needed to live independently ranges from 18 – 20 $ml \cdot kg^{-1} \cdot min^{-1}$ (Cress & Meyer, 2003, Morey et al., 1998 & Posner et al., 1995). Those with aerobic capacity in this range are most likely in a transitional range, which has been described as a precipice or "slippery slope" where any further loss in aerobic capacity results in a disproportional loss in physical function (Schwartz, 1997).

The impact of various life events that interrupt physical activity such as a short bout of pneumonia or elective surgery can result in rapid decline in physical function of older adults differently depending upon their aerobic capacity prior to the interruption in physical activity (Wagner, LaCroix, Buchner, & Larson, 1992). Experiencing the same loss in aerobic capacity, the adult with high aerobic capacity may have a minimal loss in physical function after several days of hospitalization, while an older adult with low aerobic capacity will have greater loss in physical function leading to functional dependence (Schwartz, 1997). Aerobic training is an effective method for older adults to maintain this minimal aerobic capacity needed for independence (Blumenthal et al., 1989).

Exercise Training

Regardless of previous physical activity patterns and current training status, older adults demonstrate a positive response to aerobic training (Stamford, 1988). The degree of change with training, expressed in relative terms, appears to be comparable to that demonstrated by younger subjects (Stamford, 1988). Exercising for about 30 minutes per day, three times per week for at least eight weeks can improve an older adult's VO_{2max} by approximately 3.5 $ml \cdot kg^{-1} \cdot min^{-1}$(Green & Crouse, 1995). An increase of this amount could prove to be the difference between independent daily living and reliance on some form of assistance, a benefit highly valued by a great many elderly individuals and their caregivers (Green & Crouse, 1995).

Researchers have shown that sixteen weeks of aerobic training increases peak oxygen consumption by 11.6% in older adults with a mean baseline VO_{2peak} value of 19.4±5.3 $ml \cdot kg^{-1} \cdot min^{-1}$ (Blumenthal et al., 1989), resulting in a physical reserve of about 2 $ml \cdot kg^{-1} \cdot min^{-1}$. Endurance training for eight weeks at moderate intensity improved VO_{2max} by 11% in older adults (Poehlman et al., 1994). Research has also demonstrated that twelve weeks of high intensity endurance training increased VO_{2max} by 38% in 60 – 70 year old men (Makrides et al., 1990). A six-month endurance training program in older adults 60-79 years old increased VO_{2max} by 16% with moderate intensity aerobic activity and by 26.9% with high intensity training (Braith et al., 1994). Additionally, a 12 month endurance training program at moderate intensity increased VO_{2max} by 20 - 30% in 60 – 70 year old women and men (Kohrt et al., 1991). In contrast, not all studies demonstrate improvements in aerobic capacity after endurance training. A study of 25 older women divided into three groups of high intensity aerobic training, moderate intensity training and stretching did not increase peak aerobic capacity after nine months (DiPietro et al., 2006). By in large there is consistent evidence that endurance training can improve maximal oxygen consumption in older adults. However, little is known about the influence of experimentally induced increases in aerobic capacity on physical function.

Theoretically, older adults with lower aerobic capacity and physical function have the most to gain from interventions that maintain or improve physical performance (King et al., 2002). Exercise interventions can provide beneficial effects on functional capacity (Ettinger, 1996). A twelve-week progressive resistance-training program of 21 women 70 years and older demonstrated significant improvements in physical function measured by the Short Physical Performance Battery (SPPB) (Bean et al, 2004). In a sample of 116 women, a six-month strength and balance exercise program induced improvements in balance and chair stand components of the SPPB but not the total score (Campbell et al., 1997). A low-intensity exercise program increased physical function determined by the SPPB total score in 105 men and women over a six-month time period (DeVito, et al., 2003). A six-month multidimensional home-based exercise program improved physical function measured by the SPPB and the Physical Performance Test (PPT) in 72 men and women (Nelson et al., 2004). Also a nine-month flexibility, balance, strength and endurance training program demonstrated significant improvements in physical function determined by the modified PPT with a sample of 115 men and women (Binder et al, 2002). Additionally, Cress et al., 1999 demonstrated significant improvements in physical function using the Continuous Scale Physical Functional Performance (CS-PFP) test after a six-month aerobic and strength training program in a sample of 49 men and women. A 16-week strength and power training program in a sample of 35 men and women demonstrated that power training improved physical function determined by the CS-PFP more than strength training (Miszko et al., 2003). A six-month resistance training program improved physical function measured by the CS-PFP in a sample of cardiac women (Ades et al., 2003, Brochu et al., 2002). However, Barnett et al, 2003 did not demonstrate significant improvements in self-reported physical function (SF36PF) after a six month community-based functional exercise program in a sample of 163 older people. Also a ten-week home-based resistance training program did not increase the SF36PF scores in functionally impaired men and women (Chandler et al, 1998). In summary the literature suggests that performance-based measures have greater sensitivity to detect change due to exercise intervention than self-report functional assessment. Studies using the SPPB and the PPT had sample sizes of 70 and greater, whereas the studies using the CS-PFP had sample size of less than 35 and still detected change.

Researchers have demonstrated that walking provides numerous health benefits, yet strength training or a combination of strength and aerobic training programs have been the most frequently used intervention to improve physical function (Ades et al., 2003, Bean et al, 2004, Binder et al., 2002, Cress et al., 1999). Walking, a type of activity that requires little additional skill or training to perform can improve performance and aerobic capacity (Wong et al., 2003). Habitual walking may play a role in the prevention of disability by maintaining and/or improving daily physical function and functional reserve, and increasing the level of activity (Wong et al., 2003). Researchers have demonstrated that encouraging more activity can be as simple as establishing walking programs in the community (USDHHS, 2002).

CHAPTER 3

ASSESSMENT OF PHYSICAL FUNCTION IN LOW SOCIOECONOMIC OLDER ADULTS[1]

[1] Moore, T.L. and Cress, M.E. To be submitted to Journal of American Geriatrics Society

ABSTRACT

OBJECTIVES. Older adults with low socioeconomic status are at increase risk of disability. The objective of this study was to examine disability and the relationships of some frequently used physical function measures with established benchmarks for identifying risk of disability in older adults with low education and low income.

DESIGN. Descriptive study.

SETTING. Community-based public housing apartment building with residents from the greater Athens, Georgia area.

PARTICIPANTS. Twenty-six community-dwelling older adults.

MEASUREMENTS. Physical function was assessed using four different measures: Continuous Scale Physical Functional Performance 10 item test (CS-PFP 10), Physical Performance Test (PPT), Short Physical Performance Battery (SPPB), and the Medical Outcomes Study Short Form Health Survey Physical Function subscale (SF36PF). Descriptive statistics were used to determine the means and standard deviations. Pearson product moment correlations were used to quantify the relationships between physical function variables and to assess gender differences.

RESULTS. The mean age of the participants was 71.5±8.1 years (60-90 yrs). Eighty-eight percent of the participants were at risk for preclinical disability of which 50% were at risk for moderate disability. The performance-based physical function measures were correlated ($p<0.05$) with each other, however the SF36PF was only correlated with the PFP-10 ($p<0.05$).

CONCLUSION. In this sample the participants at risk by virtue of low socioeconomic status were stratified into risk categories of moderate and low risk of disability using the SPPB. Participant's preclinical disability status was identified by a mis-match between self-report and performance-based function, where self-report function was greater than performance. These

individuals could benefit from physical activity intervention programs to improve physical function. Those individuals with high functional performance on the CS-PFP 10 had a physical reserve. Those who have low physical performance and low self-report may already be receiving services or less likely to comply with a physical activity program due to multiple co-morbidities.

KEY WORDS: physical function, preclinical disability, low socioeconomic older adults

INTRODUCTION

With the older adult population steadily increasing, researchers are focusing on quality as well as quantity of life.[1] Quality of life of an older adult includes not only specific disease processes but also the level of functioning.[2] This level of functioning can mean the difference between independent and dependent living. Accurate assessment of physical function can be used to evaluate change in functional capacity, health status, and risk prediction to prevent future adverse events. Valid and reliable measures of physical function are important for accurate assessment of functional risk and strategizing interventions to maintain independence.

Self-report and performance-based physical function assessments provide valuable information about functional limitations and predict health-related outcomes in older adults.[2,3] Self-report measures are commonly used because they are easily administered, economical, and provide insights into a person's perception of function.[4] However, self-report measures more than performance-based measures are apt to be influenced by psychosocial factors such as cognitive impairment and depression.[2,5] Environmental factors such as living status can also play a role in self-report physical function measures,[6] These factors can contribute to limitations in the ability to detect a range or a change in function.[2,7] Self-report combined with performance-based measures of physical function have been shown to predict preclinical disability.[8]

Since 1990, several performance-based measures have been developed to quantify functional performance, a shift in focus from functional limitation as measured in self-report questionnaires to observed ability.[8,9,10] Performance-based measures range from a single item such as the six-minute walk to multi-item tests such as the Physical Performance Test, and from a single focus such as the Short Physical Performance Battery focus on mobility to multidimensional concepts such as the Continuous Scale Physical Functional Performance 10 item test (CS-PFP 10), a global measure of physical function with subscales for strength, flexibility, balance & coordination, and endurance. Objective performance assessment is relatively independent of educational, cognitive, and cultural bias.[2] Performance-based measures may require adequate space, specific equipment, special training of assessors, and more time to administer[2,11] than self-report measures. These performance-based and self-report measures have established benchmarks for preclinical disability and risk of disability. Preclinical disability is defined as functional loss before the recognition of difficulty performing tasks [12].

In a descriptive study to better understand how to interpret these measures and the relationships between some frequently used physical function measures, we administered several functional assessment tools with benchmarks for identification of risk of preclinical disability or disability in a population that is demographically defined as being "at risk" for loss of independence. The measures chosen include the Continuous Scale Physical Functional Performance 10 item test (CS-PFP 10), Short Physical Performance Battery (SPPB), Physical Performance Test 7-item (PPT 7-item), Physical Performance Test 9-item (PPT 9-item) and the SF36 Physical Function subscale (SF36PF). We hypothesized that these physical functional measures would correlate with each other and that the CS-PFP 10 would identify older adults at risk for preclinical disability.

METHODS

Subjects

Men and women ages 60 and older were recruited using flyers, public service announcements, and presentations at older adult facilities in the Athens, Georgia community. Twenty-six of the forty volunteers were eligible using a health screen and having received medical clearance from their physician to participate in the study. All participants signed a written informed consent approved by University of Georgia's Institutional Review Board. Exclusion criteria included poorly controlled or unstable cardiovascular disease, unstable angina as characterized by an abrupt increase in the frequency of angina or angina at rest or angina symptoms of >2 on a scale of 1-4, heart failure, uncontrolled arrhythmias, severe and symptomatic aortic stenosis, uncontrolled casual blood glucose >200 mg/dl (casual is defined as blood glucose taken at any time of day without regard to the time of the last meal), severe psychiatric illness that limits cooperation in general and the ability to follow directions or keep appointments, uncontrolled hypertension or a blood pressure of >140/90 at rest, leg or arm amputation, excessive alcohol intake defined as >3 drinks/day, terminal illness (life expectancy < 1 year), and other conditions that are aggravated by exercise as identified by their physician.

Self-Reported Physical Function

Medical Outcome Survey

The Medical Outcomes Study Short Form Health Survey (SF36) is a reliable and valid self-report questionnaire that assesses eight health domains: physical functioning, role-physical, bodily pain, general health, vitality, social functioning, role-emotional, and mental health.[13,14] The SF36 physical function (SF36PF) subscale uses a three-level response: (limited a lot, limited a little, or not limited at all) to assess 10 physical limitations.[3] Scores range from 0-to-100, with 0 reflecting poorer self-rated health status. A score of <65 indicates low probability of independence.[8] The SF36PF was administered prior to the performance-based physical function measures so participants did not gain insights from their performance.

Functional Performance Measurements

Short Physical Performance Battery (SPPB)

The Short Physical Performance Battery of lower extremity function is a valid measure that predicts mortality and institutionalization in community-dwelling older adults with a broad range of abilities.[15] The SPPB consists of (1) three standing balance measures (tandem, semi-tandem, and side-by-side stands), (2) five continuous chair stands, and (3) an 8-foot walk. The three balance tests are considered as hierarchical in difficulty in assigning a single score of 0-to-4 for standing balance.[15] Individuals who cannot complete the tasks are given the score of 0. Individuals who complete the tasks will be assigned scores of 1-to-4 based on their time, with the fastest time being scored as a 4. The scores for the 8-foot walk, chair stands, and balance measures are summarized to get a total score ranging from 0-to-12.[15] Epidemiological studies indicate that older adults with total scores of 4-to-6 have a high risk, scores of 7-to-9 have a moderate risk and scores of 10-to-12 have a low risk of nursing home admission, incident disability, and mortality.[9,16]

Physical Performance Test (PPT)

The Physical Performance Test is a reliable and valid measure that assesses multiple aspects of physical function using observed performance of tasks that simulate activities of daily living of various degrees of difficulty.[17] The 7-item test consists of (1) writing a sentence, (2) simulated eating, (3) lifting a book, (4) putting on and removing a jacket, (5) picking up a penny from the floor, (6) turning 360 degrees, and (7) walking 50 feet. The 9-item test includes the 7-item tasks with the addition of (8) climbing one flight of stairs and (9) the number of flights of stairs climbed. Each item is scored based on a five-point scale (0-to-4) in which "0" is "unable to complete" and "4" is "most capable or fastest". The best possible score on the 7-item test is

28 and 36 on the 9-item test.[17] A PPT score of 15-to-18 has been reported to be predictive of death or nursing home placement in older adults.[10]

Continuous Scale Physical Functional Performance 10 item test (CS-PFP 10)

The Continuous Scale Physical Functional Performance 10 item test, a shortened version of the Continuous Scale Physical Functional Performance (CS-PFP) test,[18] is a reliable and valid measure of physical function that preserves the important information provided by the CS-PFP.[19] The CS-PFP 10 is comprised of 10 household tasks performed sequentially where time, distance and weight are used to evaluate functional ability. The CS-PFP 10 is a reflection of the person's functional capacity, as each task is performed at maximal effort within the person's judgment of comfort and safety. Tasks that are quantified using both weight and time include: (1) carrying a pot of weight from one counter to another; and (2) carrying groceries onto and off a 4-step platform. Tasks that are quantified by time alone include: (1) transferring laundry; (2) donning and removing a jacket; (3) sweeping kitty litter into a dustpan; (4) climbing stairs; (5) sitting down and getting up from the floor; and (6) picking up four scarves from the floor. Tasks that are quantified by distance include: (1) a 6-minute walk and (2) a maximal reach using an adjustable shelf. A detailed description of the tasks and test set-up is available at www.coe.uga.edu/cspfp. The test is administered in a standardized environment with a set dialogue. The raw scores for each task are adjusted to a scale of 0-to-100, where 0 is the poorest performance. The average of all scores is used to determine the CS-PFP 10 total score and the average task scores for each domain determine each total domain score. Physical domain scores include upper body strength (UBS), upper body flexibility (UBF), lower body strength (LBS), balance and coordination (BALC), and endurance (END). A score of <57 (55-58) indicates decreased probability of living independently or preclinical disability.[8]

STATISTICAL ANALYSIS

Data were analyzed using SPSS (version 13.0, SPSS, Inc., Chicago, IL) statistical software package. Descriptive statistics were used to determine the means and standard deviations. Pearson product moment correlations were used to quantify the relationships between physical function variables and to assess gender differences. Statistical significance was set at alpha level ≤ 0.05.

RESULTS

Selected characteristics are listed in Table 1. The participants were predominantly low socioeconomic older adults. Thirty-eight percent of the participants' annual income fell below poverty level ($9570 annually).[20] The descriptive physical function scores are reported in Table 2. Eighty-eight percent of the participants were at risk for preclinical disability of which 50% were at risk for moderate disability. (Table 3). There were no floor effects, meaning there were no individuals unable to perform at least one of the tasks on any of the physical function measures. However, ceiling effects, individuals clustered at the top of the range, were found on the SPPB (7.7%), PPT 7-item (7.7%), and the SF36PF (11.5%). No ceiling effects were found on the CS-PFP 10 and PPT 9-item. Correlations among the physical function measures are reported in Table 4. The relationship among the physical function measures remained significant after limiting the sample to just females. All performance-based physical function measures were correlated ($p<0.05$) with each other, however the SF36PF was only correlated with the CS-PFP 10 ($p<0.05$).

DISCUSSION

Disability can influence quality of life, mortality, health care needs, and institutionalization[21]. Risk factors for risk of disability are age (60 and older), being female, race

(African American), income (≤$20,000 a year) and fewer years of education[22-26]. The sample studied in this research population was older (mean age = 71.5), low income (≤$20,000; 80.8%), women (84.6%), with limited education (high school or less; 61.5%) and minority status (African Americans 34.5%). One purpose of this research was to examine the level of disability in this population. Only 15% of the participants had a physical reserve and were not at risk of preclinical disability using the >57 benchmark on the CS-PFP 10 and ≥65 on the SF36PF (Table 3.3). Fifty percent of the participants were at moderate risk for disability using the 7-to-9 benchmark on the SPPB. Approximately 27% of the participants were determined to be at risk for dependency using the benchmark of <65 on the SF36PF. All study participants were found to be above the benchmark established for risk of nursing home placement and death using the PPT 7-item (<15). Therefore, the focus of the discussion is on the SF36PF, SPPB and CS-PFP 10 scores. The performance-based measures were significantly correlated (r = 0.695- 0.974) as shown in Table 3.4. The self-report SF36PF was significantly correlated with only the CS-PFP 10 total performance-based measure.

To better understand the risk of preclinical disability, the participants were divided into categories based on high (≥65 on the SF36PF & ≥57 on the CS-PFP 10) and low (<65 on the SF36PF & <57 on the CS-PFP 10) self-report and performance-based physical function[8]. Approximately 15% (n = 4) of the participants had alignment between high self-report (SF36PF ≥65; mean = 86.3) and high performance-based function (≥57 on CS-PFP 10; mean = 62.4). The SPPB mean score was 11 indicating that these individuals were at the lowest risk for disability. The alignment of high self-report and high performance-based function with confirmation on the SPPB (low risk of disability) was an indicator of functional independence. Approximately 58% (n = 15) of the participants had inconsistent alignment between self-report and performance-based function, reporting high function (SF36PF ≥65; mean = 83.9) and demonstrating low functional performance (CS-PFP 10 <57; mean = 47.9). These individuals can be categorized as having preclinical disability and are at moderate risk for disability with a mean score of 9 on the SPPB. These participants may show the greatest benefit from a physical activity intervention. If these individuals become aware of their limited functional performance, they may be motivated to participate in an intervention. The final 27% (n = 7) of the participants were aligned with low self-report (SF36PF <65; mean = 42.5) and low performance-based (CS-PFP 10 <57; mean = 39). The SPPB mean score was 8 also indicating that this portion of the sample is at moderate risk for disability. These data may forecast the need of support services such as meals on wheels for these individuals to remain living in their same environment.

This study has several limitations. The sample size was small and there was a lack of individuals in the highest risk for disability (SPPB <6; PPT 7-item <15). This may have been in part due to the institutional requirements that all participants receive a physician's clearance to participate in the study. Future research is warranted to examine a larger sample size with individuals that have a broad range of functional abilities and to evaluate the ability of a physical activity program to improve function.

In conclusion, in this sample the participants at risk by virtue of low socioeconomic status were stratified into risk categories of moderate and low risk of disability using the SPPB. Participant's preclinical disability status was identified by a mis-match between self-report and performance-based function, where self-report function was greater than performance. These individuals could benefit from physical activity intervention programs to improve physical function and the ability to remain independent. Those individuals with high functional performance on the CS-PFP 10 had a physical reserve. Those who have low physical performance and low self-report may already be receiving services or less likely to comply with a physical activity program due to multiple co-morbidities.

REFERENCES

1. Guralnik JM, LaCroix AZ. Assessing physical function in older adults. In: Wallace RB, Woodson RF, eds. *The Epidemiologic Study of the Elderly.* New York, NY: Oxford University Press Inc; 1992: 159-181.

2. Guralnik JM., Branch LG, Cummings SR et al. Physical performance measures in aging research. *Journal of Gerontology: MEDICAL SCIENCES.* 1989; 44(5):M141-6.

3. Ware JE Jr. Development of the SF-36. *SF-36 Health Survey; Manual & Interpretation Guide.* Boston, Massachusetts: Nimrod Press; 1993:3:1-3:22.

4. Sayers SP, Jette AM, Haley SM et al. Validation of the late-life function and disability instrument. *Journal of American Geriatrics Society*. 2004;52:1552-1559.

5. Cress ME, Schectman KB, Mulrow CD et al. Relationship between physical performance and self-perceived physical function. *Journal of American Geriatrics Society.* 43(2):93-101.

6. Myers AM, Holliday PJ, Harvey KA et al. Functional performance measures: are they superior to self-assessment?. *Journal of Gerontology.* 1993;48(5):M196-206.

7. Reuben DB, Valle LA, Hays RD et al. Measuring physical function in community-dwelling older persons: a comparison of self-administered, interviewer-administered, and performance-based measures. *Journal of American Geriatrics Society.* 1995;43:17-23.

8. Cress ME, Meyer M. Maximal voluntary and functional performance levels needed for independence in adults aged 65 to 97 years. *Physical Therapy*. 2003;83(1):37-48.

9. Guralnik JM, Ferrucci L, Simonsick EM et al. Lower extremity function in persons over the age of 70 years as a predictor of subsequent disability. *New England Journal of Medicine*. 1995;332:556-561.

10. Reuben DB, Rubenstein LV, Hirsch SH. Value of functional status as a predictor of mortality: results of a prospective study. *The American Journal of Medicine.* 1992;93:663-669.

11. Hoeymans N, Feskens E, van den Bos G et al. Measuring functional status: cross-sectional and longitudinal associations between performance and self-report (Zutphen elderly study 1990-1993). *Journal of Clinical Epidemiology*. 1996;49:1103-1110.

12. Fried, L. P., Herdman, S., Kuhn, K et al. Preclinical disability: hypotheses about the bottom of the iceberg. *Journal of Aging and Health.* 1991 3(2):285-300.

13. McHorney CA, Ware JE Jr, Rogers W et al. The validity and relative precision of MOS short- and long-form health status scales and Dartmouth COOP charts. Results from the Medical Outcomes Study. *Medical Care.* 1992;30(5Suppl):MS253-65.

14. Ware JE, Sherbourne CD. The MOS 36-item short form health survey (SF36). Conceptual framework and item selection. *Medical Care*. 1992;30:473-483.

15. Guralnik JM, Simonsick E, Ferrucci L et al. A short physical performance battery assessing lower extremity function: association with self-reported disability and prediction of mortality and nursing home admission. *Journal of Gerontology: MEDICAL SCIENCES*. 1994;49(2):M85-M94.

16. Guralnik JM, Ferrucci L, Pieper CF et al. Lower extremity function and subsequent disability: consistency across studies, predictive models, and value of gait speed alone compared with the short physical performance battery. *Journal of Gerontology: MEDICAL SCIENCES*. 2000;55A(4):M221-M231.

17. Reuben DB, Siu AL. An objective measure of physical function of elderly outpatients. *Journal of American Geriatric Society*. 1990;38:1105-1112.

18. Cress ME, Buchner DM, Questad KA et al. Continuous-scale physical functional performance in healthy older adults: a validation study. *Archives of Physical Medicine and Rehabilitation*. 1996;77:1243-1250.

19. Cress ME, Petrella JK, Moore TL et al. Continuous scale-physical functional performance test: validity, reliability, and sensitivity of data for the short version. *Physical Therapy* 2005;85(4):323-335.

20. Leavitt, M. Annual update of the health and human services poverty guidelines. *Federal Register*. 70(33):8373-8375, 2005.

21. Guralnik JM, Fried, LP, Salive ME. Disability as a public health outcome in the aging population. *Annual Review of Public Health*. 1996;17:25-46.

22. Guralnik JM, Land KC, Blazer D et al. Educational Status and active life expectancy among older Blacks and Whites. *New England Journal of Medicine.* 1993;329:110-116.

23. House JS, Lepkowski JM, Kinney AM et al. The social stratification of aging and health. *Journal of Health and Social Behavior*. 1994;35:213-234.

24. LaCroix AZ, Guralnik JM, Berkman LF et al. Maintaining mobility in late life. II. Smoking, alcohol consumption, physical activity, and body mass index. *American Journal of Epidemiology*. 1993;137:858-869.

25. Stuck AE, Walthert JM, Nikolaus T et al. Risk factors for functional status decline in community-living elderly people: A systematic literature review. *Social Science and Medicine*. 1999;48:445-469.

26. Melzer D, Izmirlian G, Leveille SG et al. Educational differences in the prevalence of mobility disability in old age: The Dynamics of incidence, mortality, and recovery. *Journal of Gerontology: Social Sciences*. 2001;56B(5):S294-S301.

Table 3.1. Characteristics of Study Population

	N = 26
Age (y), mean ± SD	71.5±8.1
Gender (% female)	84.6%
Race (%)	
Caucasian	65.4%
African-American	34.6%
Education (%)	
Less than 12 years	23.0%
High school completed	38.5%
College degree	38.5%
Annual Income	
≤$20,000	80.8%

Table 3.2. Physical Function Scores (N=26)

	MEAN±SD	RANGE
SF 36 Physical Function subscale	74.2±19.3	25-100
Short Physical Performance Battery	9.3±2.0	2-12
Physical Performance Test 7-item	23.3±3.3	15-28
Physical Performance Test 9-item	29.7±4.5	17-35
Continuous Scale Physical Functional Performance 10 item test	45.7±12.7	11.1-68.5

Table 3.3 Percentage of Participants at Risk (N=26)

	SF36PF	SPPB	PPT 7-item	CS-PFP 10
Range of possible scores	0-100	0-12	0-28	0-100
Actual data range	25-100	2-12	15-28	11.1-68.5
At risk summary score	<65	≤9	<15	<57
High risk of disability	-------	3.8%	------	------
Moderate risk of disability	-------	50.0%	-----	------
Risk of death or NHP	-------	------	0%	------
Preclinical disability	26.90%	------	------	84.6%

Notes: SF36PF= Self-reported 36 Physical Function subscale;
SPPB = Short Physical Performance Battery;
PPT 7-item = Physical Performance Test 7-item;
CS-PFP 10 = Continuous Scale Physical Functional Performance-10 test;
NHP = Nursing Home Placement

Table 3.4. Correlations of Physical Function Measures (N=26)

	SF36PF	SPPB	PPT 7-item	PPT 9-item	CS-PFP 10
SF36PF	1.000	0.192	0.269	0.361	0.511**
SPPB		1.000	0.695**	0.731**	0.720**
PPT 7-item			1.000	0.974**	0.819**
PPT 9-item				1.000	0.822**
CS-PFP 10					1.000

Notes: SF36PF = SF36 Physical Function subscale; SPPB = Short Physical Performance Battery; PPT 7-item = Physical Performance Test 7-item; PPT 9-item = Physical Performance Test 9-item; CS-PFP 10 = Continuous Scale Physical Functional Performance 10 item test

** $p < 0.01$

CHAPTER 4

THE EFFECTS OF AEROBIC TRAINING AND NUTRITION EDUCATION ON FUNCTIONAL PERFORMANCE IN LOW SOCIOECONOMIC OLDER ADULTS[2]

[2] Moore, T.L., Speer, E., Johnson, F., Johnson, M.A, Cress, M.E. To be submitted to Medicine & Science in Sports & Exercise

ABSTRACT

Older adults, with low income, low education, and low physical reserves are at disproportional higher risk for chronic disease burden, functional limitations and disability and therefore may benefit from a physical activity program. **PURPOSE:** This study investigated the effects of a walking intervention or a nutrition education intervention on functional performance in a randomized controlled trial of low socioeconomic older adults. We hypothesized that the walking exercise group would demonstrate significant improvements compared to the control group in functional performance after the intervention. **METHODS:** Twenty-four older adults with a mean age of 70.4±7.3 years were randomized to a walking exercise (WE) (N=12) or control group (N=12). The WE group participated in walking at an aerobic intensity of 60-75% of maximum heart rate for 1 hour 3x/week for 16-weeks. The control group received biweekly nutrition education presentations. Peak aerobic capacity and physical function were measured at baseline and after the 16-week intervention. **RESULTS:** The WE group significantly improved in peak aerobic capacity (18.9%), physical function (25%) when evaluated by the Continuous Scale Physical Functional Performance 10 item test compared to control group. The Physical Performance Test , Short Physical Performance Battery, and the Medical Outcomes Study Short Form Health Survey Physical Function subscale did not demonstrated significant improvement. **DISCUSSION:** Our findings highlight the importance of physical activity and indicates that walking, a simple exercise that can be done without specialized exercise leader or equipment can significantly increase peak aerobic capacity and physical function in just four months.

KEY WORDS: PHYSICAL RESERVE, PEAK AEROBIC CAPACITY

INTRODUCTION

Older adults, with low income, low education, and low physical reserves are at disproportional higher risk for chronic disease burden, functional limitations and disability (16) due to poor health and lifestyles that occur more frequently among individuals of low socioeconomic status (25). Physical inactivity is more prevalent among women, minorities, older adults, and the less affluent (27). Physical inactivity in the older adult population has become a national public health risk; only 10% adheres to the ACSM and CDC recommended exercise guidelines (14, 21).

Regular physical activity, a proven public health strategy to reduce disease, disability, and improve quality of life for older persons, is a non-pharmacological intervention for management of chronic disease (20). Physically active individuals have lower health care utilization (22). These benefits are particularly important for low socioeconomic older adults who are more apt to lack health care coverage and financial resources for assistance with disability (17).

The key to late life independence may lie in midlife strategies that preserve physiologic capacity and maintain physical reserve. Physical reserve, physiological capacity in excess of that required for the performance of activities of daily living, can be increased through endurance training. Walking, a popular and effective method of increasing peak aerobic capacity is easily implemented in populations with limited resources for an exercise leader or facilities. This study was designed to evaluate the effect of a walking or nutrition education intervention on functional performance with a randomized controlled trial in low socioeconomic older adults. We hypothesized that the walking exercise group would demonstrate significant improvements in functional performance after the intervention.

METHODS

Subjects. Forty men and women aged 60 and older were recruited from the Athens, Georgia community. Twenty-six volunteers (22 women and 4 men) received medical clearance from their physician and signed a written informed consent approved by University of Georgia's Institutional Review Board. Subjects were excluded from the study if they met the following criteria: poorly controlled or unstable cardiovascular disease, unstable angina as characterized by an abrupt increase in the frequency of angina or angina at rest or angina symptoms of >2 on a scale of 1-4, heart failure, uncontrolled arrhythmias, severe and symptomatic aortic stenosis, uncontrolled casual blood glucose >200 mg/dl (casual is defined as blood glucose taken at any time of day without regard to the time of the last meal), severe psychiatric illness that limits cooperation in general and the ability to follow directions or keep appointments, uncontrolled hypertension or a blood pressure of >140/90 at rest, leg or arm amputation, excessive alcohol intake defined as >3 drinks/day, terminal illness (life expectancy < 1 year), and other conditions that are aggravated by exercise as identified by their physician.

Experimental design. Participants were randomized into a control or a walking exercise group. Baselines measures were evaluated before and after the 16-week intervention. Health status questionnaires were completed prior to performance tests so participants did not gain insights from their performance. Peak oxygen consumption testing and physical function tests took place on different days within a week time period. The control group was given the opportunity to join the walking program after completion of exit testing.

Self-reported health status. The Medical Outcomes Study 36-Item Short Form Health Survey (SF36) is a reliable and valid self-report measure of general health, functioning, and quality of life. The SF36 consists of eight health concepts: vitality, role-physical, role-emotional, physical function, mental health, general health, bodily pain, and social functioning (29). Scores range from 0-to-100, with 0 reflecting the poorest self-rated health status. A score of <65 indicates low probability of independence (9). The SF36PF was administered prior to the performance-based physical function measures so participants did not gain insights from their performance.

Physical Function. The Continuous Scale Physical Functional Performance 10 item test (CS-PFP 10), a shortened version of the Continuous Scale Physical Functional Performance (CS-PFP) test (7) is a reliable and valid measure of physical function that preserves the important information provided by the CS-PFP (10). The CS-PFP 10 is comprised of 10 household tasks performed sequentially under standard conditions and with a scripted dialogue. The CS-PFP 10 is a reflection of the person's functional capacity, as each task is performed at maximal effort within the person's judgment of comfort and safety. Tasks that are quantified using both weight and time include: (1) carrying a pot of weight from one counter to another; and (2) carrying groceries onto and off a 4-step platform. Tasks that are quantified by time alone include: (1) transferring laundry; (2) donning and removing a jacket; (3) sweeping kitty litter into a dustpan; (4) climbing stairs; (5) sitting down and getting up from the floor; and (6) picking up four scarves from the floor. Tasks that are quantified by distance include: (1) a 6-minute walk and (2) a maximal reach using an adjustable shelf. A detailed description of the tasks and test set-up is available at www.coe.uga.edu/cspfp. The raw scores for each task are adjusted to a scale of 0-to-100, where 0 is poorest performance. The measurements are summarized into a total score and five physical domains. The average of all scores is used to determine the CS-PFP 10 total score and the average task scores for each domain determine each total domain score. Physical domain scores include upper body strength (UBS), upper body flexibility (UBF), lower body strength

(LBS), balance and coordination (BALC), and endurance (END). A score of <57 (55-58) indicates decreased probability of living independently or preclinical disability (9).

Peak Aerobic Capacity. Peak aerobic capacity (VO_{2peak}) was assessed using a modified Balke treadmill protocol (2). During a 2-minute warm-up, the fastest, most comfortable walking speed was determined and then maintained throughout the test while elevation was increased 2% every 2 minutes. A 12-lead electrocardiogram (Q-Stress® Exercise Test Monitor, Quinton. Inc., Bothell, WA) was continuously monitored by a physician. Heart rate and blood pressure were recorded each minute. Oxygen consumption measurements were collected at 30 second intervals using the Parvo Medics TrueOne 2400 Metabolic Measurement System (Parvo Medics, Inc., Salt Lake City, UT). Using the Borg scale (6-20 scale), rating of perceived exertion was recorded at the end of each stage (4). Peak aerobic capacity was defined as the highest value of oxygen consumption attained during the treadmill test. Participants were tested to volitional exhaustion and met at least two of the three criteria: (1) maximum achieved heart rate within 10 beats/min of age-predicted maximum heart rate (13, 26), (2) respiratory exchange ratio of greater than 1.0 (11), or (3) rating of perceived exertion of at least 18 on the Borg 6-20 Rating of Perceived Exertion Scale (13).

Leg Strength. Leg strength was assessed from a one-repetition maximum (1RM) using the leg press machine (Alliance Rehabilitation System, Chattanooga Group, Inc., Hixson, TN), where 1RM is the maximal amount of weight that can be lifted once through the full range of motion while holding to good form (28). After four-to-five warm-up repetitions, resistance was added until a maximal weight could be lifted. Participants were given 30 second rest periods between each lift.

Exercise Intervention. While the walking program focused on endurance, balance and flexibility training were also included. The supervised classes met three times a week for 16 weeks. The program consisted of a 10-minute warm-up, 10 – 40 minutes of walking, followed by a 10-minute cool-down. Initially, participants were encouraged to walk for 10-minutes continuously. The duration of continuous walking was increased to 40-minutes by week eight. An exercise intensity of 60-75% of heart rate maximum (HRmax) was monitored using heart rate monitors (Polar A series) and also by Borg's 6-20 self-rated perceived exertion (RPE) scale (4). The participants were taught to identify a RPE of 12-14, which is considered as moderate intensity (24). Balance and flexibility exercises were included in the warm-up and cool-down segments of the class. Participants were encouraged to attend all exercise classes (48 sessions) with make-up classes arranged as needed for those who missed classes. All participants were required to attend two consecutive weeks of classes before exit testing. The classes were held at Denney Tower that is a predominantly older adult public housing apartment complex in Athens, GA, along a cityscape walking path.

Nutrition Intervention Controls. The control group was given information about the benefits of nutrition with a focus on fruits and vegetables using the lessons from the NOAHnet program (www.arches.uga.edu/~noahnet/) during bi-weekly presentations. Participants were given the opportunity to join the walking program after the sixteen-week intervention.

Statistical Analysis. Data were analyzed using the SPSS (version 13.0, SPSS Inc., Chicago, IL) statistical software package. Descriptive statistics were calculated to obtain the means and standard deviations of each group. Linear regression was used to determine the contribution of change in physiological capacity (VO_{2peak} and 1RM) to change in function (CS-PFP 10, SPPB, and PPT). Only those variables that had significant correlations were entered into the regression equation. Pearson product moment correlations were used to quantify the relationships between the physiological capacity and physical function measures. ANOVA was used to determine group by time effects of the intervention on physiological capacity and functional measures. Statistical significance was set at $p<0.01$. Results were reported as means ± standard deviations.

RESULTS

The demographic and selective characteristics of the participants are listed in Table 1. Twenty-six of forty volunteers were enrolled in the study. Sixteen volunteers were either unable to obtain physician clearance (N=7), or denied by their physician (N=4), or decided not to participate in the study (N=3). Two volunteers, one from the control and one from the walking exercise group were not entered into the intervention programs due to the inability to complete the peak aerobic capacity test. Twenty-four older adults completed the study. Seventy-nine percent of the participants had an annual income of ≤$20,000. In addition, 38% fell below poverty level (<$9570 annually) (18). At baseline, no significant differences were found between the groups in physical characteristics, physical function, peak aerobic capacity, leg strength and self-reported health status. Eighty-eight percent (n = 21) of the participants met at least two of the three criteria for peak aerobic capacity at baseline and post intervention testing (Table 4.4). Participant's compliance with attending the exercise class was 88.5%. All physical domains of the CS-PFP 10 significantly improved in the walking exercise group (Table 2). The CS-PFP 10 total score increased significantly by 25% (effect size = 0.75) compared to the 8.3% decline in the control group (Figure 4.1). Peak aerobic capacity increased significantly by 18.9% (effect size = 0.46) in the walking exercise group compared to the control group which experienced a 9.2% reduction in peak aerobic capacity (Figure 4.2). The correlation between the change in peak aerobic capacity and the change in physical function was r = 0.846. Both groups demonstrated nonsignificant improvements (7% control group and 6.6% walking exercise group) in 1RM. The change in peak aerobic capacity accounted for 87% (Beta = .873) of the variance in the change in CS-PFP 10 total. The walking exercise group showed a trend toward improvement in all health concepts of the SF36 (Table 3). CS-PFP 10 was the only physical function measure that detected a significant change in physical function after the intervention (Figure 4.3).

DISCUSSION

Most studies have used samples that are predominately affluent, well educated Caucasians, this research is important because it is one of the few randomized controlled trials to focus on improving function in lower socioeconomic older adults. The purpose of this study was to compare the effects of a walking intervention and nutrition education on functional performance in lower socioeconomic older adults. At least 85% of the participants were at risk for preclinical disability (Moore , Chapter 3), indicating that this may benefit from a physical activity program to increase function forestall further declines in function.

The results of this study indicate that peak aerobic capacity improved by 18.9% (effect size = 0.46) in our population after the sixteen-week walking program (Figure 4.2). Our findings (Figure 4.2) are similar to previous studies on older adults where the aerobic capacity increased by 11-30% (3, 5, 15, 23). Physical function improved in these study participants by 25% (effect size = 0.75) using CS-PFP 10 total score (Figure 4.1). These improvements in function are similar to those found in other studies that used exercise training as an intervention (14% to 24%) (6, 8, 19). This study adds to the literature by showing a causal relationship between change in peak aerobic capacity and change in physical function (r = 0.846). For each unit improvement in peak aerobic capacity the average improvement in CS-PFP 10 was four units. Previous work from this laboratory has determined 20 $ml \cdot kg \cdot min^{-1}$ as the threshold between physical function and aerobic capacity above which increases in aerobic capacity are a physical reserve (9). The improvement in peak aerobic capacity provided the walking exercise group with a physical reserve of 3.6 $ml \cdot kg \cdot min^{-1}$. A physical reserve can make the difference between independent daily living and reliance on some form of assistance (12). The reduction in peak aerobic capacity (9.2%) left the control group without the benefit of a physical reserve. Before the intervention only 33% of the walking exercise group was above the benchmark of 57 on the CS-PFP 10 for loss of independence while following the intervention, nearly 75% of the walking exercise group was above the benchmark for loss of independence (CS-PFP 10 <57).

Our findings indicate that the CS-PFP 10 was more responsive than the SPPB, the PPT 9-item or the SF36PF which did not detect significant functional improvement after the intervention (Figure 4.3). A possible explanation for the inability to detect change maybe the need for a larger sample size due to ordinal scaling of the SPPB and PPT 9-item measures.

While the walking program mainly focused on endurance and lower body strength, compared to the control group the walking exercise group showed significant improvements in the upper body strength, upper body flexibility, balance and coordination domains of the CS-PFP 10. These improvements may have resulted from participants increasing their routine activities of daily living resulting in overall improvements in all domains. Previous studies have shown that walking is convenient and easily accommodated into any daily routine (30). Compliance with the program was 88.5% indicating that the participants tolerated a walking program held in Georgia in the months of May – September. Program satisfaction can be gauged by the 100% retention rate from both the control group and the walking exercise group. Walking in pairs and program leadership may have also contributed to the compliance and satisfaction with the walking program.

This study has several limitations. The assessors were not blinded to the treatment groups. The sample size was small. This may have been in part due to the institutional requirements that all participants receive a physician's clearance to participate in the study.

Further research is warranted to determine if walking programs that are low cost and easily implemented could lead to public health strategies that decreased health care utilization and delay dependency. Continued research is needed in lower socioeconomic populations to gather more information on interventions that preserve function. In summary, our findings highlight the importance of physical activity and indicate that walking, a simple exercise that can be done without specialized exercise leader or equipment can significantly increase peak aerobic capacity and physical function in just four months.

REFERENCES

1. Ades, P. A., P. D. Savage, M. E. Cress, M. Brochu, N. M. Lee, and E. Poehlman. Resistance training on physical performance in disabled older female cardiac patients. *Medicine and Science in Sports and Exercise.* 35(8):1265-1270, 2003.

2. Binder, E. F., S. J. Birge, R. Spina, et al. Peak aerobic power is an important component of physical performance in older women. *Journal of Gerontology: BIOLOGICAL SCIENCES & MEDICAL SCIENCES*. 54:M353-M356, 1999.

3. Blumenthal J. A., C. F. Emery, D. J. Madden, et al. Cardiovascular and behavioral effects of aerobic exercise training in healthy older men and women. *Journal of Gerontology*. 44(5):M147-157, 1989.

4. Borg, G. A. Psychophysical bases of perceived exertion. *Medicine and Science in Sports and Exercise.* 14(5):377-381, 1982.

5. Braith R. W., M. L. Pollock, D. T. Lowenthal, J. E. Graves, M. C. Limacher. Moderate- and high-intensity exercise lowers blood pressure in normotensive subjects 60 to 79 years of age. *The American Journal of Cardiology*. 73:1124-1128, 1994.

6. Brochu, M., P. Savage, M. Lee, et al. Effects of resistance training on physical function in older disabled women with coronary heart disease. *Journal of Applied Physiology*. 92:672-678, 2002.

7. Cress, M. E., D. M. Buchner, K. A. Questad, P.C. Esselman, B. J. deLateur, and R. S. Schwartz. Continuous-scale physical functional performance in healthy older adults: a validation study. *Archives of Physical Medicine and Rehabilitation*. 77:1243-1250,1996.

8. Cress, M. E., D. M. Buchner, K. A. Questad, P.C. Esselman, B. J. deLateur, and R. S. Schwartz. Exercise: effects on physical functional performance in independent older adults. *Journal of Gerontology: BIOLOGICAL SCIENCES & MEDICAL SCIENCES.* 54(5):M242-M248, 1999.

9. Cress, M. E. and M. Meyer. Maximal voluntary and functional performance levels needed for independence in adults aged 65 to 97 years. *Physical Therapy*. 83(1):37-48, 2003.

10. Cress, M. E., J. K. Petrella, T. L. Moore, and M. L. Schenkman. Continuous-scale physical functional performance test: validity, reliability, and sensitivity of data for the short version. *Physical Therapy* 85(4):323-335, 2005.

11. Drinkwater, B. L. Women and exercise: physiological aspects. *Exercise and Sport Science Review.* 12:21-51, 1984.

12. Green J. S. and S. F. Crouse. The effects of endurance training on functional capacity in the elder: a meta-analysis. *Medicine and Science in Sports and Exercise.* 27(6):920-926, 1995.

13. Howley, E., D. Bassett, and H. Welch. Criteria for maximal oxygen uptake: review and commentary. *Medicine and Science in Sports and Exercise*. 27:1292-1301, 1995.

14. Kushi, L. H., R. M. Fee, A. R. Folsom, P. J. Mink, K. E. Anderson, and T. A. Seller. Physical activity and mortality in postmenopausal women. *Journal of the American Medical Association*. 277(16):1287-1292, 1997.

15. Kohrt, W., M. Malley, A. Coggan, et al. Effects of gender, age, and fitness level on response of VO_2max to training in 60-71 yr olds. *Journal of Applied Physiology*. 71(5):2004-2011, 1991.

16. Lantz, P. M., J. W. Lynch, J. S. House, et al. Socioeconomic disparities in health change in a longitudinal study of US adults: the role of health-risk behaviors. *Social Science & Medicine*. 53:29-40, 2001.

17. Lawler, K. Aging in place: coordinating housing and health care provision for America's growing elderly population. Joint Center for Housing Studies of Harvard University Neighborhood Reinvestment Corporation, 2001.

18. Leavitt, M. Annual update of the health and human services poverty guidelines. *Federal Register*. 70(33):8373-8375, 2005.

19. Miszko, T. A., M. E. Cress, J. M. Slade, C. J. Covey, S. K. Agrawal, and C. E. Doerr. Effect of strength and power training on physical function in community-dwelling older adults. *Journal of Gerontology: MEDICAL SCIENCES*. 58A(2):171-175, 2003.

20. National blueprint increasing physical activity among adults 50 and older. *The Robert Wood Johnson Foundation.* 2001.

21. Pahor, M., J. M. Guralnik, M. E. Salive, E. A. Chrischilles, S. L. Brown, and R. B. Wallace. Physical activity and risk of severe gastrointestinal hemorrhage in older persons. *Journal of the American Medical Association.* 272(8):595-599, 1994.

22. Perkins, A. J. and D. O. Clark, Assessing the association of walking with health services use and costs among socioeconomically disadvantaged older adults. *Preventive Medicine*. 32:492-501, 2001.

23. Poehlman E. T., A. W. Gardner, P. J. Arciero, M. I. Goran, and J. Calles-Escandon. Effects of endurance training on total fat oxidation in elderly persons. *Journal of Applied Physiology*. 76(6):2281-2287, 1994.

24. Pollock, M. L. and J. H. Wilmore. *Exercise in Health and Disease*. Philadelphia: Saunders, 1990.

25. Reijneveld, S. A. The impact of individual and area characteristics on urban socioeconomic differences in health and smoking. *International Journal of Epidemiology*. 27:33-40, 1998.

26. Taylor, H. L., E. Buskirk, and A. Henschel. Maximal oxygen intake as an objective measure of cardio-respiratory performance. *Journal of Applied Physiology*. 8(1):73-80, 1955.

27. U.S. Department of Health and Human Services. Healthy People 2010, 2nd ed. With Understanding and Improving Health and Objectives for Improving Health. 2 vols. Washington, D.C., U.S. Government Printing Office, 2000.

28. Wade, G. Tests and measurements: Meeting the standards of professional football. *National Strength & Conditioning Association Journal*. 4(3):23, 1982.

29. Ware, J. E. Jr. and C. D. Sherbourne. The MOS 36-item short form health survey (SF36). Conceptual framework and item selection. *Medical Care*. 30:473-483, 1992.

30. Wong, C. H., S. F. Wong, W. S. Pang, M. Y. Azizah, and M. J. Dass. Habitual walking and its correlation to better physical function: implications for prevention of physical disability in older persons. *Journal of Gerontology: MEDICAL SCIENCES*. 58A(6):555-560, 2003.

Table 4.1. Selected Characteristics

	Walking Exercise (N=12)	Control (N=12)
Age (yr, mean ± SD)	68.6±7.6	72.3±6.8
Gender (% females)	83.3%	83.3%
Race (% African American)	41.7%	16.7%
Education (% ≤12 years)	33.3%	33.3%
Annual Income (% ≤$20,000)	75.0%	83.3%
Weight (kg, mean ± SD)	79.5±17.0	72.5±15.6
Height (cm, mean ± SD)	167.4±10.9	164.2±8.9

Table 4.2 Baseline and Post Intervention Continuous Scale Physical Functional Performance 10 Item Test Scores

	Walking Exercise		Control		
	Baseline	Post Intervention	Baseline	Post Intervention	p-value
CS-PFP 10 total score	51.5±9.8	64.3±11.9*	44.7±9.3	41±8.1	0.001
Upper body Strength	52.1±17.2	63.9±13.8*	42.1±11.7	38.7±11.9	0.001
Upper body Flexibility	72.2±9.7	82.3±9.1*	66.7±16.6	61.4±14.2	0.003
Lower Body Strength	42.3±11.9	55.5±14.1*	34.8±8.2	31.9±8.2	0.001
Balance & Coordination	51.9±9.8	64.8±12.4*	46.6±9.7	42.4±8.4	0.001
Endurance	53.0±9.9	66.7±12.5*	46.5±10.0	42.8±8.0	0.001

Values are mean ± SD.

*Significantly different (p<0.01) at
Post Intervention between groups

Table 4.3. Baseline and Post Intervention SF36 Scores

	Walking Exercise		Control		
	Baseline	Post Intervention	Baseline	Post Intervention	p-value
Physical Functioning	81.7±18.6	85.8±13.6	66.3±23.9	65±16.4	0.554
Role-Physical	77.1±39.1	81.3±21.7	85.4±16.7	83.3±32.6	0.706
Bodily Pain	68.1±17.5	69.3±25.2	61.9±19.7	60.7±20.2	0.788
General Health	70.7±13.0	74.8±13.1	74.3±11.8	71.6±11.8	0.278
Vitality	66.3±17.1	66.7±15.1	66.3±12.6	60.0±9.8	0.232
Social Functioning	89.6±12.9	89.6±14.9	92.7±15.5	82.3±22.3	0.179
Role-Emotional	75.0±35.2	83.3±33.3	88.9±21.7	88.9±29.6	0.530
Mental Health	78±14.2	82±12.9	87.3±6.8	82.7±11.9	0.075

Values are means ± SD

Table 4.4 Peak Aerobic Capacity Criteria

	Group	Age	Sex	Baseline			Post Intervention		
				HR	RPE	RER	HR	RPE	RER
1	N	74	F	X	X		X	X	X
2	N	79	F	X			X	X	
3	N	67	M	X		X	X	X	X
4	WE	65	M	X	X			X	X
5	N	73	F		X	X	X	X	X
6	N	77	F	X				X	
7	WE	65	F	X	X	X	X		X
8	N	74	F	X	X		X	X	X
9	N	77	F	X		X		X	
10	WE	60	F	X	X	X	X	X	X
11	WE	73	F	X		X	X	X	X
12	WE	74	F	X	X	X	X	X	X
13	WE	84	F	X	X		X	X	
14	N	64	M	X	X	X	X	X	X
15	WE	62	F	X	X	X	X	X	X
16	N	63	F	X	X		X	X	
17	N	66	F	X	X	X	X	X	X
18	WE	67	F	X	X	X	X	X	X
19	WE	79	F	X				X	
20	WE	60	F	X	X	X	X	X	X
21	N	85	F	X	X		X	X	X
22	WE	65	M	X		X	X	X	X
23	N	69	F	X	X	X	X	X	X
24	WE	69	F	X	X	X	X	X	

N = nutrition education; WE = walking exercise; F = female; M = male; X = criteria met in category; HR criteria = maximum heart rate ±10 beats of age predicted heart rate (220-age); RPE criteria = rating of perceived exertion of at least 18; RER criteria = respiratory exchange ratio of greater than 1.0.

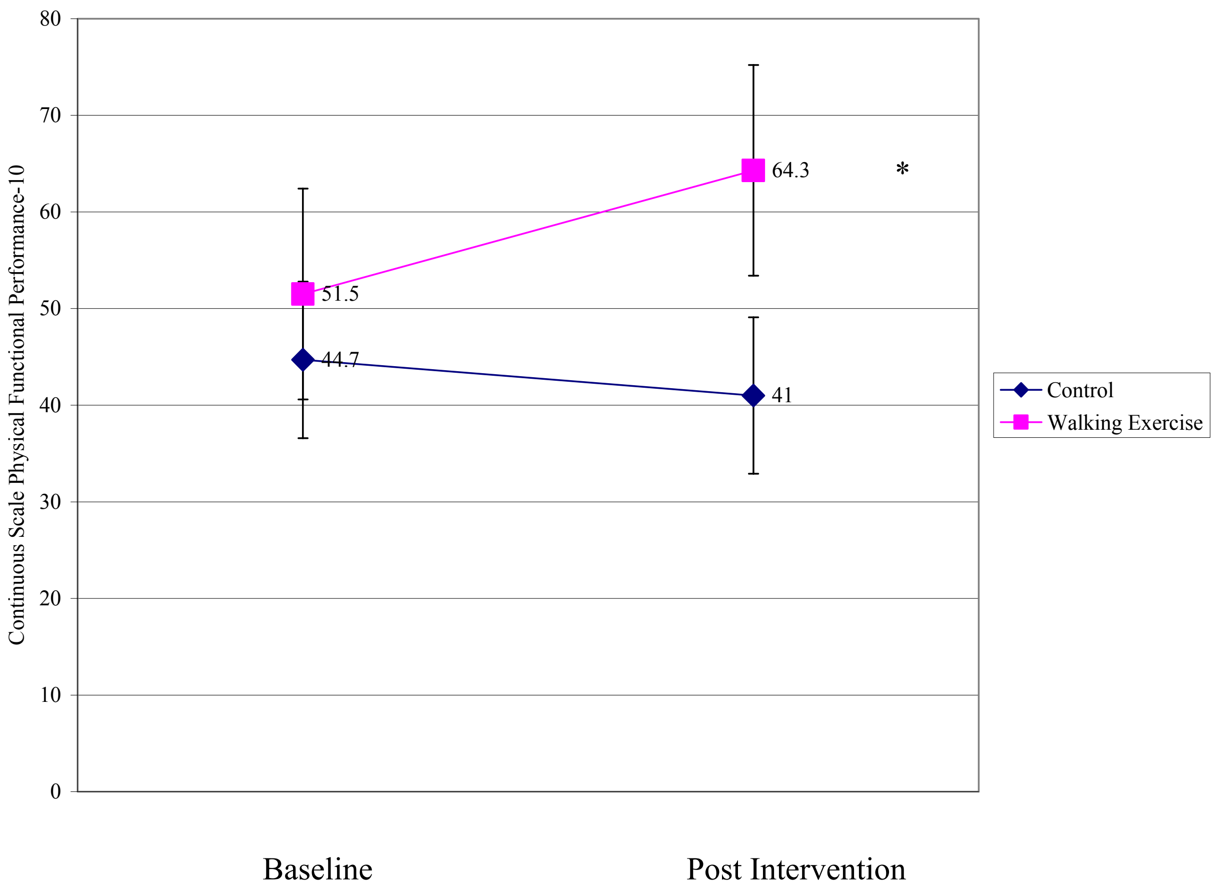
Figure Legends:

Figure 4.1: Continuous Scale Physical Functional Performance 10 item test total baseline and post intervention scores expressed as means ± SD. *Significantly different after the intervention ($p < 0.01$).

Figure 4.2: Peak aerobic capacity baseline and post intervention values expressed as mean ± SD. *Significantly different after the intervention ($p <0.01$).

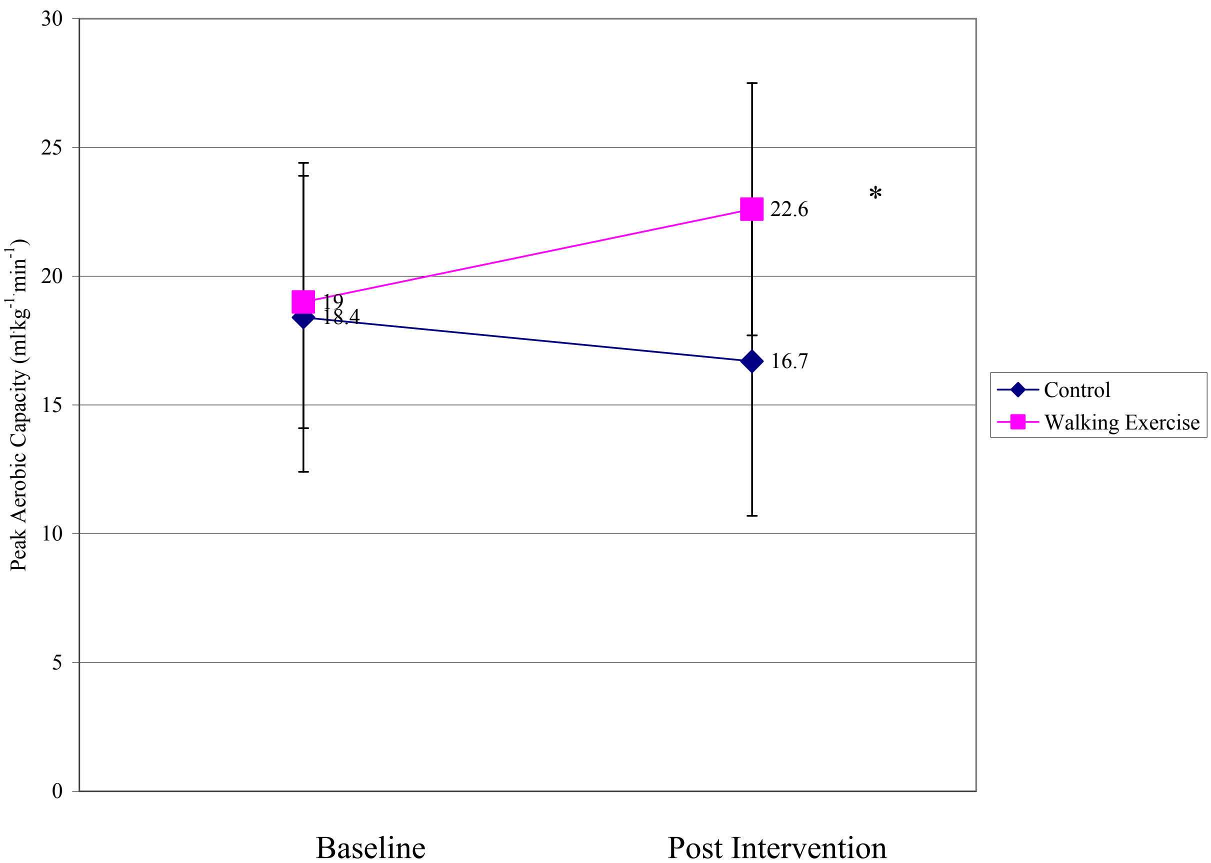
Figure 4.3: Percent change in physical function using the Continuous Scale Physical Functional Performance 10 item test (CS-PFP 10), Short Physical Performance Battery (SPPB), Physical Performance Test 9-item (PPT 9-item), Self-report Physical Function subscale (SF36PF) for the control group (open bars) and walking exercise group (closed bars) expressed as mean change ± SD. *Significantly different after the intervention ($p <0.01$).

Figure 4.1



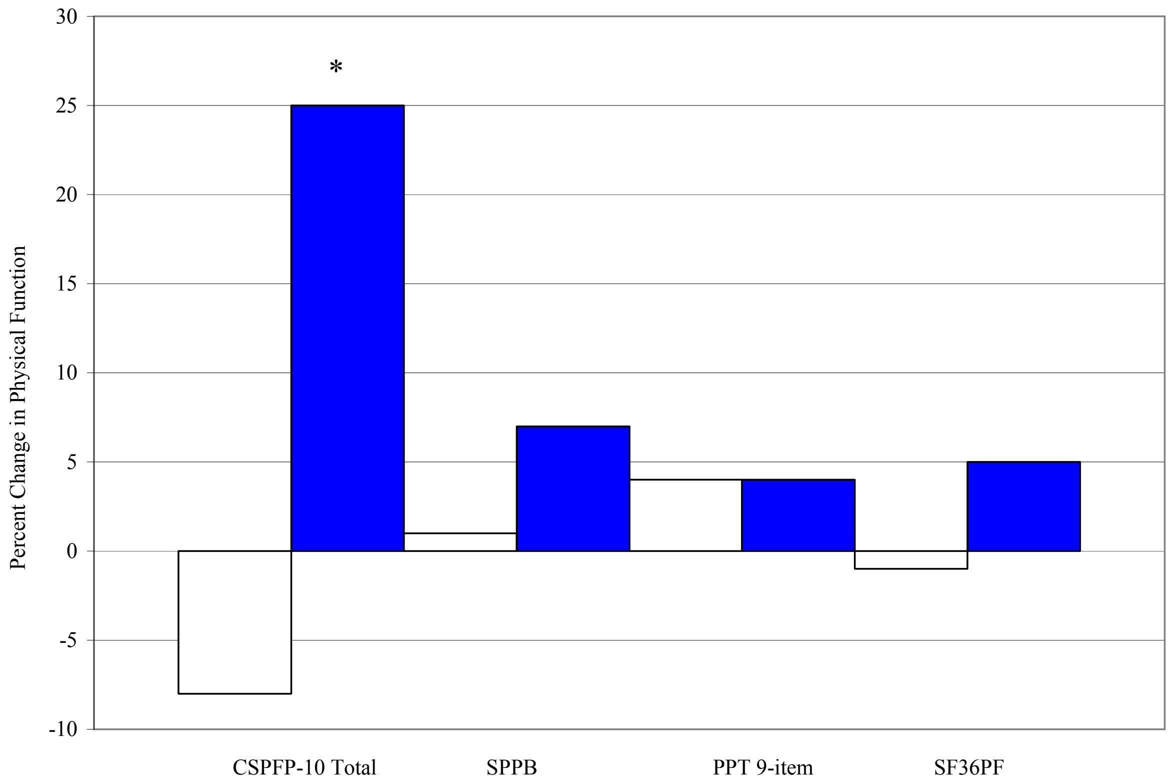
80
70
60
50
40
30
20
10
0
Continuous Scale Physical Functional Performance-10
64.3
*
51.5
44.7
41
Control
Walking Exercise
Baseline
Post Intervention

Figure 4.2



30
25
20
15
10
5
0
Peak Aerobic Capacity (ml·kg-1·min-1)
22.6
*
19
18.4
16.7
Control
Walking Exercise
Baseline
Post Intervention

Figure 4.3



30
25
20
15
10
5
0
-5
-10
*
Percent Change in Physical Function
CSPFP-10 Total
SPPB
PPT 9-item
SF36PF

CHAPTER 5

SUMMARY & CONCLUSIONS

The increase in longevity has researchers are focusing on quality as well as quantity of life.. In order to preserve the quality of life, numerous measures have been developed to assess functional performance. Some of the frequently used physical function measures are the SF36PF, PPT 7-item, PPT 9-item, SPPB and the CS-PFP 10. However, these assessments evaluate different aspects of functional limitation and disability. The SF36PF is a self-report questionnaire that is used in combination with the CS-PFP 10 to predict risk of preclinical disability (Cress & Meyer, 2003). The PPT 7 & 9-item assesses multiple aspects of physical function using observed performance of tasks and predicts mortality and nursing home placement (Reuben & Siu, 1990). The SPPB predicts risk of disability, mortality and institutionalization by measuring mobility (Guralnik et al., 1994). The CS-PFP 10 is a global performance-based test of everyday activities that predicts loss of independence and preclinical disability (Cress et al., 2005).

Older adults, with low income, low education, and low physical reserves are at disproportionally higher risk for chronic disease burden, functional limitations and disability (Lantz et al., 2001), due to poor health and lifestyles that occur more frequently among individuals of low socioeconomic status (Reijneveld, 1998). These older adults are the most inactive and have the greatest need for a physical activity program. Increasing physical activity is one of the most feasible non-pharmacological interventions to prevent and control chronic disease. Walking is the most popular form of physical activity for all adults and arguably most likely to cause change (Department of Health, 2000). A type of activity that requires little additional skill or training to perform can improve performance and aerobic capacity (Wong et al., 2003). Even though walking is readily accessible and has low potential for injury (Moore, 1989), there is limited information on walking as a means to preserve function in older adults.

In the first study, the relationships between one self-report and four performance-based physical function measures were evaluated. The SF36PF, CS-PFP 10, PPT 7-item, PPT 9-item and SPPB are reliable and valid physical function measures for the older adult population. Our results demonstrated that all performance-based measures were correlated ($p<0.01$) with each other. However the SF36PF was only correlated with the CS-PFP 10 ($p<0.01$). Eighty-eight percent of the participants were at risk for preclinical disability of which 50% were at risk for moderate disability. Participant's preclinical disability status was identified by a mis-match between self-report and performance-based function, where self-report function is greater than performance. These individuals could benefit from physical activity intervention programs to improve physical function and the ability to remain independent. Those individuals with high functional performance on the CS-PFP 10 had a physical reserve. Those who have low physical performance and low self-report may already be receiving services or less likely to comply with a physical activity program due to multiple co-morbidities.

In the second study, we examined the effects of a randomized controlled trial of walking and nutrition education on functional performance. The walking exercise group participated in a moderate intensity walking program three times a week and the control group attended nutrition presentations every two weeks for 16-weeks. Our findings demonstrated that as a result of the walking program the participants significantly improved CS-PFP 10 by 25% and peak aerobic capacity by 18.9%. In contrast, the participants in the control group showed a trend toward decreased physical function and peak aerobic capacity. All physical domains of the CS-PFP 10 significantly improved. This study demonstrated that a simple walking program that requires no special equipment can improve peak aerobic capacity and functional performance similar to strength training studies that require equipment.

From the evidence presented, we conclude that walking can be a beneficial nonpharmacological strategy to improve function and maintain independence in older adults. For the population of older adults to understand the importance of physical activity, the country as a whole must make physical activity a priority. Physical activity does not have to be strenuous to be beneficial; people of all ages benefit from participating in regular, moderate-intensity physical activity, such as 30 minutes of brisk walking five or more times a week (ACSM, 2001).

REFERENCES

Ades, P. A., Savage, P. D., Cress, M. E., Brochu, M., Lee, N. M. & Poehlman, E. T. (2003). Resistance training on physical performance in disabled older female cardiac patients. *Medicine and Science in Sports and Exercise.* 35(8):1265-1270.

Administration on Aging, U.S. Department of Health and Human Service. (2003). *Current Population Survey, Annual Social and Economic Supplement, "Income, Poverty, and health Insurance Coverage in the United States"*: P60-226, issued August, 2003, by the U.S. Bureau of the Census, related Census detailed tables on the Census Bureau web site, and from Fast Facts and Figures About Social Security, 2004, Social Security Administration

American College of Sports Medicine's Resource Manual for Guidelines for Exercise Testing and Prescription. (2001). Baltimore, Maryland, Lippincott Williams & Wilkins. 529-533.

Astrand, I., (1960). Aerobic work capacity in men and women with special reference to age. *Acta Physiological Scandavian* Supplement. 169:1-92.

Barnett, A., Smith, B., Lord, S. R., Williams, M., & Bauman, A. (2003). Community-based group exercise improves balance and reduces falls in at-risk older people: a randomized controlled trial. *Age and Ageing.* 32:407-414.

Bean, J. F., Herman, S. Kiely, D. K., Frey, I. C., Leveille, S. G., Fielding, R. A., & Frontera, W. R. (2004). Increased velocity exercise specific to task (InVEST) training: a pilot study exploring effects on leg power, balance, and mobility, in community-dwelling older women. *Journal of American Geriatrics Society.* 52:799-804.

Centers for Disease Control and Prevention (2005). *Behavioral Risk Factor Surveillance System Survey Data.* Atlanta, Georgia: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention.

Binder, E. F., Schechtman, K. B., Ehsani, A. A., Steger-May, K., Brown, M., Sinacore, D. R., Yarasheski, K. E., & Holloszy, J. O. (2002). Effects of exercise training on frailty in community-dwelling older adults: results of a randomized, controlled trial. *Journal of American Geriatrics Society.* 50:1921-1928.

Blair, S. N. (1993). C.H. McCloy research lecture: Physical activity, physical fitness, and health. *Research Quarterly in Exercise & Sport*. 54:365-376.

Blumenthal J. A., Emery C. F., Madden, D. J., George, L. K., Coleman, R. E., Riddle, M. W., McKee, D. C., Reasoner, J. & Williams, R. S. (1989). Cardiovascular and behavioral effects of aerobic exercise training in healthy older men and women. *Journal of Gerontology*. 44(5):M147-157.

Braith R. W., Pollock, M. L., Lowenthal, D. T., Graves, J. E., Limacher, M. C. (1994). Moderate-and high-intensity exercise lowers blood pressure in normotensive subjects 60 to 79 years of age. *The American Journal of Cardiology*. 73:1124-1128.

Brochu, M., Savage, P., Lee, M., Dee, J., Cress, M. E., Poehlman, E. T., Tischler, M. & Ades, P. (2002). Effects of resistance training on physical function in older disabled women with coronary heart disease. *Journal of Applied Physiology*. 92:672-678.

Buchner, D. M. & deLateur, B. J. (1991). The importance of skeletal muscle strength to physical function in older adults. *Behavioral Medicine Annals*. 13:420-426.

Campbell, A. J. & Buchner, D. M. (1997). Unstable disability and the fluctuations of frailty. *Age and Ageing.* 26:315-318.

Campbell, A. J., Robertson, M. C., Gardener, M. M., Norton, R. N., Tilyard, M. W., & Buchner, D. M. (1997). Randomised controlled trial of a general practice programme of home based exercise to prevent falls in elderly women. *British Medical Journal.* 315:1065-1069.

Caspersen, C. J. (1987). Physical inactivity and coronary heart disease. *Physician and Sports Medicine.* 15(11):43-44.

Caspersen, C. J., Powell, K. E., & Christenson, G. M. (1985). Physical activity, exercise, and physical fitness: definitions & distinctions for health-related research. *Public Health Reports.* 100(2):126-131.

Chandler, J. M., Duncan, P. W., Kochersberger, G., & Studenski, S. (1998). Is lower extremity strength gain associated with improvement in physical performance and disability in frail, community-dwelling elder? *Archives of Physical Medicine and Rehabilitation.* 79:24-30.

Clark, D. O. (1995). Racial and educational differences in physical activity among older adults. *The Gerontologist.* 35:472-480.

Cohen-Mansfield, J., Marx, M. S., & Guralnik, J. M., (2003). Motivators and barriers to exercise in an older community-dwelling population. *Journal of Aging and Physical Activity*. 11:242-253.

Colditz, G. A. (1999). Economic costs of obesity and inactivity. *Medicine and Science in Sports and Exercise.* 31(11 Suppl):S663-S667.

Cress, M. E., Buchner, D. M., Questad, K. A., Esselman, P. C., deLateur, B. J., & Schwartz, R. S. (1996). Continuous-scale physical functional performance in healthy older adults: a validation study. *Archives of Physical Medicine and Rehabilitation*. 77:1243-1250.

Cress, M. E., Buchner, D. M., Questad, K. A., Esselman, P. C., deLateur, B. J., & Schwartz, R. S. (1999). Exercise: effects on physical functional performance in independent older adults. *Journal of Gerontology: BIOLOGICAL SCIENCES & MEDICAL SCIENCES.* 54(5):M242-M248.

Cress, M. E., & Meyer, M. (2003). Maximal voluntary and functional Performance levels needed for independence in adults aged 65 to 97 years. *Physical Therapy*. 83(1):37-48.

Damush, T. M., Stewart, A. L., Mills, K. M., King, A. C., & Ritter, P. L. (1999). Prevalence and correlates of physician recommendations to exercise among older adults. *Journal of Gerontology: BIOLOGICAL SCIENCES and MEDICAL SCIENCES.* 54(8):M423-M427.

DeNavas-Walt, C., Proctor, B., & Lee, C. (2004). U.S. Census Bureau, Current Population Reports, *Income, Poverty, and Health Insurance Coverage in the United States*; U.S. Government Printing Office, Washington, DC. 60-229.

DeVito, C. A., Morgan, R. O., Duque, M. Abdel-Moty, E., & Virnig, B. A. (2003). Physical performance effects of low-intensity exercise among clinically high-risk elder. *Gerontology.* 49(3):146-154.

DiPietro, L., Dziura, J., Yeckel, C., & Neufer, D. (2006). Exercise and improved insulin sensitivity in older women: evidence of the enduring benefits of higher intensity training. *Journal of Applied Physiology.* 100:142-149.

Ensrud, K., Nevitt, M., Yunis, C., Cauley, J., Seeley, D., Fox, K., & Cummings, S. (1994). Correlates of impaired function in older women. *Journal of American Geriatrics Society*. 42:481-489.

Ettinger, W. H. (1996). Physical activity and older people: A walk a day keeps the doctors away. *Journal of American Geriatrics Society.* 44:207-208.

Ettinger, W. H., Burns, R., Messier, S. P., Applegate, W., Rejeski, W. J., Morgan, T., Shumaker, S., Berry, M., O'Toole, M., Monu, J., & Craven, T. (1997). A randomized trial comparing aerobic exercise and resistance exercise with a health education program in older adults with knee osteoarthritis. *Journal of American Medical Association*. 227(1):25-31.

Fiatarone, M. A., O'Neill, E. F., Ryan, N. D., Clements, K. M., Solares, G. R., Nelson, M. E., Roberts, S. B., Kehayias, J. J., Lipsitz, L. A., & Evans, W. J. (1994). Exercise training and nutritional supplementation for physical frailty in very elderly people. *The New England Journal of Medicine*. 333(25):1769-1775.

Frederiks, C. M., te Wierik, M. J. Visser, A., & Sturmans, F. (1990). The functional status and utilization of care of elderly people living at home. *Journal of Community Health*. 15:307-317.

Fried, L. P. & Guralnik, J.M. (1997). Disability in older adults: evidence regarding significance, etiology, and risk. *Journal of American Geriatrics Society.* 45(1):92-100.

Fried, L. P., Herdman, S., Kuhn, K., Rubin, G., & Turano, K. (1991). Preclinical disability: hypotheses about the bottom of the iceberg. *Journal of Aging and Health.* 3(2):285-300.

Green, J. S. & Crouse, S. F. (1995). The effects of endurance training on functional capacity in the elder: a meta-analysis. *Medicine and Science in Sports and Exercise.* 27(6):920-926.

Guralnik, J. M., Branch, L. G., Cummings, S. R., & Curb, J. D. (1989). Physical performance measures in aging research. *Journal of Gerontology: MEDICAL SCIENCES.* 44(5):M141-6.

Guralnik, J. M., Ferrucci, L., Simonsick, E. M., Salive, M. E., & Wallace, R. B. (1995). Lower extremity function in persons over the age of 70 years as a predictor of subsequent disability. *New England Journal of Medicine*. 332:556-561.

Guralnik, J. M., Ferrucci, L., Pieper, C. F., Leveille, S. G., Markides, K. S., Ostir, G. V., Studenski, S., Berkman, L. F., & Wallace, R. B. (2000). Lower extremity function and subsequent disability: consistency across studies, predictive models, and value of gait speed alone compared with the short physical performance battery. *Journal of Gerontology: MEDICAL SCIENCES*. 55A(4):M221-M231.

Guralnik J.M., Fried, L.P., & Salive M.E. (1996). Disability as a public health outcome in the aging population. *Annual Review of Public Health*.17:25-46.

Guralnik, J. M. & LaCroix, A. Z. (1992). Assessing physical function in older adults. In: Wallace RB, Woodson RF, eds. *The Epidemiologic Study of the Elderly.* New York, NY: Oxford University Press Inc; 159-181.

Guralnik J.M., Land, K.C., Blazer, D., Fillenbaum, G.G., & Branch, L.G. (1993). Educational Status and active life expectancy among older Blacks and Whites. *New England Journal of Medicine.* 329:110-116.

Guralnik, J. M., Simonsick, E., Ferrucci, L., Glynn, R. J., Berkman, L. F., Blazer, D. G., Scherr, P. A., & Wallace, R. B. (1994). A short physical performance battery assessing lower extremity function: association with self-reported disability and prediction of mortality and nursing home admission. *Journal of Gerontology: MEDICAL SCIENCES*. 49(2):M85-M94.

Heckler, M. M. (1985). Health promotion for the elderly. *Public Health Reports*. 100:225-230.

House, J.S., Lepkowski, J.M., Kinney, A.M., Mero, R.P., Kessler, R.C., & Herzog, A.R. (1994). The social stratification of aging and health. *Journal of Health and Social Behavior*. 35:213-234.

Howard, G., Anderson, R. T., Russell, G., Howard, V. J., & Burke, G. L. (2000). Race, socioeconomic status, and cause-specific mortality. *Annals of Epidemiology*. 10:214-223.

King, M. B., Whipple, R. H., Gruman, C. A., Judge, J. O., Schmidt, J. A., & Wolfson, L. I. (2002). The performance enhancement project: improving physical performance in older persons. *Archives of Physical Medicine and Rehabilitation*. 83:1060-1067.

Kohrt, W. M. & Holloszy, J. O. (1995). Loss of skeletal muscle mass with aging: effect on glucose tolerance. *Journal of Gerontology: BIOLOGICAL SCIENCES and MEDICAL SCIENCES*. 50:68-72.

Kohrt, W., Malley, M., Coggan, A., Spina, R., Ogawa, T., Eshani, A., Bourney, R., Martin, W., & Holloszy, J. (1991). Effects of gender, age, and fitness level on response of VO_2max to training in 60-71 yr olds. *Journal of Applied Physiology*. 71(5):2004-2011.

Kushi, L. H., Fee, R. M., Folsom, A. R., Mink, P. J., Anderson, K. E., & Seller, T. A. (1997). Physical activity and mortality in postmenopausal women. *Journal of the American Medical Association*. 277(16):1287-1292.

LaCroix, A.Z., Guralnik, J.M., Berkman, L.F., Wallace, R.B., & Satterfield, S. (1993). Maintaining mobility in late life. II. Smoking, alcohol consumption, physical activity, and body mass index. *American Journal of Epidemiology*. 137:858-869.

Lantz, P. M., Lynch, J. W., House, J. S., Lepkowski, J. M., Mero, R. P., Musick, M. A. & Williams, D. R. (2001). Socioeconomic disparities in health change in a longitudinal study of US adults: the role of health-risk behaviors. *Social Science & Medicine*. 53:29-40.

Lonergan, E.T. & Krevans, J.R. (1991). Special report. A national agenda for research on aging. *New England Journal of Medicine*. 324:1825-1828.

Makrides, L., Heigenhauser, G. J., & Jones, N. L. (1990). High-intensity endurance training in 20- to 30- and 60- to 70-yr-old healthy men. *Journal of Applied Physiology*. 69(5):1792-1798.

Mazzeo, R. S., Cavanagh, P., Evans, W. J., Fiatarone, M., Hagberg, J., McAuley, E., & Startzell, J. (1998). ACSM position stand on exercise and physical activity for older adults. *Medicine and Science in Sports and Exercise*. 30(6):992-1008.

Melzer, D., Izmirlian, G., Leveille, S.G., & Guralnik, J.M. (2001). Educational differences in the prevalence of mobility disability in old age: The Dynamics of incidence, mortality, and recovery. *Journal of Gerontology: SOCIAL SCIENCES*. 56B(5):S294-S301.

Miszko, T. A., M. E. Cress, J. M. Slade, C. J. Covey, S. K. Agrawal, and C. E. Doerr.(2003). Effect of strength and power training on physical function in community-dwelling older adults. *Journal of Gerontology: MEDICAL SCIENCES*. 58A(2):171-175.

Moore, S. R. (1989). Walking for health: a nurse-managed activity. *Journal of Gerontological Nursing.* 15(7):26-28.

Morey, M. C., Pieper, C. F., & Cornoni-Huntley, J. (1998). Is there a threshold between peak oxygen uptake and self-reported physical functioning in older adults? *Medicine and Science in Sports and Exercise.* 30(8):1223-1229.

National blueprint increasing physical activity among adults 50 and older. *The Robert Wood Johnson Foundation.* 2001.

National Center for Health Statistics. (1999). Trends in health and aging database: healthcare utilization. www.cdc.gov/nchs.

National Institute on Aging. Journal of the American Medical Association. (1996) Workshop on Performance Measures, Boston MA, 5-6.

Nelson, M. E., Layne, J. E., Bernstein, M. J., Nuernberger, A., Castaneda, C., Kaliton, D., Hausdorff, J., Judge, J. O., Buchner, D. M., Roubenoff, R., Fiatarone, & Singh, M. A. (2004). The effects of multidimensional home-based exercise on functional performance in elderly people. *Journal of Gerontology: BIOLOGICAL SCIENCES & MEDICAL SCIENCES.* 59(2):154-60

Pahor, M., Gurlanik, J. M., Salive, M. E., Chrischilles, E. A., Brown, S. L., & Wallace, R. B. (1994). Physical activity and risk of severe gastrointestinal hemorrhage in older persons. *Journal of the American Medical Association.* 272(8):595-599.

Pate, R., Pratt M., Blair, S., Haskell, W. L., Macera. C. A., Bouchard, C., Buchner, D., Ettinger, W., Heath, G. W., King, A. C., et al. (1995). Physical activity and public health: a recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *Journal of the American Medical Association*. 273:402-407.

Poehlman, E. T., Gardner, A. W., Arciero, P. J., Goran, M. I., & Calles-Escandon, J. (1994). Effects of endurance training on total fat oxidation in elderly persons. *Journal of Applied Physiology*. 76(6):2281-2287.

Posner, J. D., McCully, K. K., Landsberg, L. A. Sands, L. P. Tycenski, P., Hofmann, M. T., Wetterholt, K. L. & Shaw, C. E. (1995). Physical determinants of independence in mature women. *Archives of Physical Medicine and Rehabilitation.* 76(4):373-380.

Public Health Service. (1990). Healthy people 2000: national health promotion and disease prevention objectives. Washington, DC: US Department of Health and Human Services.

Reijneveld, S. A. (1998). The impact of individual and area characteristics on urban socioeconomic differences in health and smoking. *International Journal of Epidemiology*. 27:33-40.

Reuben, D.B., Rubenstein, L.V., & Hirsch, S.H. (1992). Value of functional status as a predictor of mortality: results of a prospective study. *The American Journal of Medicine*. 93:663-669.

Reuben, D. B., & Siu, A. L. (1990). An objective measure of physical function of elderly outpatients. *Journal of American Geriatric Society*. 38:1105-1112.

Schneider, E. L. & Guralnik, J. M. (1990). The aging of America: impact of health care costs. *Journal of American Medical Association*. 263:2335-2340.

Schwartz, R. S. (1997). Sacropenia and physical performance in old age: introduction. *Muscle & Nerve.* Supplement 5:S10-S12.

Seeman, T. E., Berkman, L. F., Charpentier, P. A., Blazer, D. G., Albert, M. A., & Tinetti, M. E. (1995). Behavioral and psychosocial predictors of physical performance: MacArthur Studies of Successful Aging. *Journal of Gerontology: BIOLOGICAL SCIENCES & MEDICAL SCIENCES*. 50A:M177-M183.

Sherman, S. E. & Reuben, D. (1998). Measures of functional status in community-dwelling elders. *Journal of General Internal Medicine*. 13(12):817-823.

Sowers, J. R. (1987). Hypertension in the elderly. *American Journal of Medicine*. 26;82(1B):1-8.

Stamford, B. A. (1988). Exercise and the elderly. *Exercise and Sport Science Review.* 16:341-379.

Stuck, A. E., Siu, A. L., Wieland, G. D., Adams, J. & Rubenstein, L. Z. (1993). Comprehensive geriatric assessment: a meta-analysis of controlled trials. *Lancet*. 342(8878):1032-6.

Stuck, A.E., Walthert, J.M., Nikolaus, T., Bula, C.J., Hohmann, C., & Beck, J.C. (1999). Risk factors for functional status decline in community-living elderly people: A systematic literature review. *Social Science and Medicine*. 48:445-469.

Tanaka, H., Desouza, C. A., Jones, P. P., Stevenson, E. T., Davy, K. P., & Seals, D. R. (1997). Greater rate of decline in maximal aerobic capacity with age in physically active vs. sedentary healthy women. *Journal of Applied Physiology*. 83:1947-1953.

The Centers for Disease Control and Prevention. (2003). Prevalence of physical activity, including lifestyle activities among adults-United States, 2000-2001. *MMWR-Morbidity & Mortality Weekly Report.* 52(32): 764-769.

U.S. Census Bureau (2003). Retrieved December 10, 2005 Income, Poverty, and Health Insurance Coverage in the United States: 2004 www.census.gov

U.S. Department of Health and Human Services. (2003). A profile of older Americans. Administration on Aging. 1-16.

U.S. Department of Health and Human Services. (2000). Healthy People 2010, 2nd ed. With Understanding and Improving Health and Objectives for Improving Health. 2 vols. Washington, D.C., U.S. Government Printing Office.

U.S. Department of Health and Human Services. (2002).Physical activity fundamental to preventing disease. Available from URL: http://aspe.hhs.gov/health/reports/physicalactivity.

U.S. Department of Health and Human Services. (2003). *Federal Register*. 68(26):6456-6458.

Verbrugge, L.M. & Jette, A.M. (1994). The disablement process. *Social Science and Medicine.* 38:1-14.

Wagner, E. H., LaCroix, A. Z., Buchner, D. M., & Larson, E. B. (1992). Effects of physical activity on health status in older adults: I: observational studies. *Annual Review of Public Health.* 13:451-468.

Wolf, S. L., Barnhart, H. X., Kutner, N. G., McNeely, E., Coogler, C., & Xu, T. (1996). Reducing frailty and falls in older persons: an investigation of Tai Chi and computerized balance training. Atlanta FICSIT Group. Frailty and Injuries: Cooperative Studies of Intervention Techniques. *Journal of American Geriatric Society*. 44(5):489-497.

Wong, C. H., Wong, S. F., Pang, W. S., Azizah, M. Y., & Dass, M. J. (2003). Habitual walking and its correlation to better physical function: implications for prevention of physical disability in older persons. *Journal of Gerontology: BIOLOGICAL SCIENCES & MEDICAL SCIENCES*. 58A(6):555-560.

Young, A. (1986). Exercise physiology in geriatric practice. *Acta Medica Scandinavica.* 711:227-232.

Young D. R., Masaki, K. H., Curb, J. D. (1995). Associations of physical activity with performance-based and self-reported physical functioning in older men: the Honolulu Heart Program. *Journal of American Geriatric Society*. 43(8):845-854.

APPENDIX

RAW DATA

Average Steps Per Day

#	Group	Age	Sex	Baseline	8-weeks	16-weeks
1	N	74	F	1408	1897	2112
2	N	79	F	3781	5563	3552
3	N	67	M	3896	3516	3489
4	WE	65	M	4053	5033	4537
5	N	73	F	4377	5680	6332
6	N	77	F	2490	1313	2046
7	WE	65	F	4078	4508	3122
8	N	74	F	2555	4326	2762
9	N	77	F	6032	6930	4346
10	WE	60	F	8099	10367	11008
11	WE	73	F	3726	5793	7431
12	WE	74	F	3891	4810	6774
13	WE	84	F	7144	9518	9349
14	N	64	M	2942	3382	4273
15	WE	62	F	5249	8734	8213
16	N	63	F	4989	4234	2894
17	N	66	F	1313	2112	2410
18	WE	67	F	7574	10479	9079
19	WE	79	F	4752	9327	8695
20	WE	60	F	1626	4727	8106
21	N	85	F	2116	1897	1485
22	WE	65	M	6544	8290	8345
23	N	69	F	2806	3347	3576
24	WE	69	F	3356	4922	3528

N = nutrition education; WE = walking exercise; F= female; M = male

Data collection method: Pedometers were worn on the participants' hip each day for two weeks at baseline, 8-weeks and 16- weeks to determine the activity levels of the control and walking exercise group. Participants put on their pedometers when they first woke up and took them off before they went to bed. Participants recorded their steps each day before going to bed in an activity log.

Baseline Nutrition Data

#	Group	Age	Sex	fv107	fv108	fv109	fv110	fv111	fv112	fv113	fv114
1	N	74	F	0	0	0	3	14	5	14	7
2	N	79	F	7	0	0	3	0	1	0	0
3	N	67	M	0	0	0	0	1	0	2	0
4	WE	65	M	7	7	0	0	0	0	0	0
5	N	73	F	1	0	4	0	2	0	5	3
6	N	77	F	6	2	1	3	6	0	6	2
7	WE	65	F	4	m/dk	4	m/dk	3	2	2	1
8	N	74	F	1	3	m/dk	0	2	3	3	1
9	N	77	F	3	14	2	m/dk	0	0	m/dk	0
10	WE	60	F	m/dk	7	0	1	5	2	14	m/dk
11	WE	73	F	5	0	0	1	2	0	1	m/dk
12	WE	74	F	7	1	3	3	7	3	7	3
13	WE	84	F	0	0	5	4	6	7	6	3
14	N	64	M	6	m/dk	3	3	4	2	2	4
15	WE	62	F	m/dk	3	2	1	2	2	1	1
16	N	63	F	0	m/dk	2	3	1	2	0	2
17	N	66	F	0	0	1	3	2	2	1	3
18	WE	67	F	m/dk	0	0	m/dk	0	m/dk	0	2
19	WE	79	F	3	2	2	2	2	2	3	2
20	WE	60	F	m/dk	m/dk	7	7	4	5	0	3
21	N	85	F	1	1	0	0	2	0	2	2
22	WE	65	M	7	1	7	2	3	0	3	1
23	N	69	F	0	0	7	7	7	2	1	2
24	WE	69	F	6	4	2	4	2	1	2	1

N = nutrition education; WE = walking exercise; F= female; M = male; fv = fruits and vegetables; m/dk = missing/do not know

Data collection method: Participants completed the Nutrition for Older Adults' Health Fruit and Vegetable Intake questionnaire at baseline and post intervention to determine their fruit and vegetable intake (http://www.arches.uga.edu/~noahnet/).

Baseline Nutrition Data

#	Group	Age	Sex	fv115	fv116	fv117	fv118	fv119	fv120	fv121	fv122
1	N	74	F	14	1	14	1	1	2	5	14
2	N	79	F	2	1	2	1	1	0	1	2
3	N	67	M	1	0	1	1	2	0	0	0
4	WE	65	M	0	0	4	0	0	0	3	1
5	N	73	F	5	0	2	0	1	1	2	4
6	N	77	F	4	1	4	2	1	1	1	2
7	WE	65	F	2	0	3	2	0	1	1	m/dk
8	N	74	F	2	1	5	0	0	0	1	1
9	N	77	F	0	m/dk	0	m/dk	m/dk	2	0	0
10	WE	60	F	6	m/dk	6	2	6	0	5	14
11	WE	73	F	m/dk	0	4	0	m/dk	0	0	0
12	WE	74	F	2	1	7	1	1	7	5	3
13	WE	84	F	3	1	1	1	0	0	6	1
14	N	64	M	2	0	3	1	0	3	3	5
15	WE	62	F	1	0	3	1	0	m/dk	1	1
16	N	63	F	3	3	2	1	0	2	2	1
17	N	66	F	2	2	4	0	0	1	4	3
18	WE	67	F	m/dk	m/dk	2	2	2	0	0	3
19	WE	79	F	7	2	m/dk	3	m/dk	1	2	4
20	WE	60	F	m/dk	m/dk	7	2	1	0	4	4
21	N	85	F	0	0	3	2	2	2	1	0
22	WE	65	M	3	0	5	5	1	1	3	2
23	N	69	F	7	1	14	3	0	0	0	3
24	WE	69	F	2	3	6	1	m/dk	3	1	3

N = nutrition education; WE = walking exercise; F= female; M = male; fv = fruits and vegetables; m/dk = missing/do not know

Baseline Nutrition Data

#	Group	Age	Sex	fv123	fv124	fv125	fv126	fv127	fv128	fv129	fv130
1	N	74	F	7	7	3	7	7	7	14	7
2	N	79	F	0	4	0	3	0	1	6	2
3	N	67	M	0	0	0	1	0	1	0	0
4	WE	65	M	7	5	0	7	0	0	1	7
5	N	73	F	6	3	1	6	1	0	6	3
6	N	77	F	3	3	3	3	2	5	1	2
7	WE	65	F	2	2	0	3	2	1	m/dk	2
8	N	74	F	5	0	4	3	6	0	3	1
9	N	77	F	2	0	m/dk	4	2	0	3	2
10	WE	60	F	7	14	7	14	m/dk	m/dk	14	14
11	WE	73	F	2	0	2	2	m/dk	m/dk	5	m/dk
12	WE	74	F	7	7	7	7	1	1	7	2
13	WE	84	F	6	0	6	14	0	6	6	0
14	N	64	M	4	4	0	14	4	m/dk	14	0
15	WE	62	F	4	2	1	4	1	0	6	2
16	N	63	F	6	3	1	3	0	1	1	0
17	N	66	F	2	1	4	2	0	2	1	0
18	WE	67	F	2	m/dk	0	0	0	2	4	2
19	WE	79	F	4	2	2	2	m/dk	0	4	3
20	WE	60	F	6	0	14	14	m/dk	m/dk	14	1
21	N	85	F	2	2	0	2	0	0	2	2
22	WE	65	M	4	1	0	7	0	2	7	5
23	N	69	F	7	6	7	7	0	0	m/dk	1
24	WE	69	F	6	2	m/dk	2	m/dk	3	6	2

N = nutrition education; WE = walking exercise; F= female; M = male; fv = fruits and vegetables; m/dk = missing/do not know

Baseline Nutrition Data

#	Group	Age	Sex	fv131	fv132	fv133	fv134	fv135	fv136	fv137	fv138
1	N	74	F	7	1	1	0	1	4	1	0
2	N	79	F	0	0	1	0	1	2	0	1
3	N	67	M	1	1	1	1	1	4	1	0
4	WE	65	M	2	1	1	1	1	5	0	0
5	N	73	F	2	0	0	0	0	5	1	0
6	N	77	F	4	1	8	1	1	3	1	1
7	WE	65	F	1	1	1	1	1	5	1	0
8	N	74	F	0	1	1	1	2	0	1	1
9	N	77	F	1	1	1	0	1	5	1	0
10	WE	60	F	m/dk	1	1	1	1	5	1	0
11	WE	73	F	m/dk	1	1	1	1	5	1	0
12	WE	74	F	2	1	1	1	1	2	1	0
13	WE	84	F	6	1	1	1	1	5	1	0
14	N	64	M	0	1	1	1	1	3	0	0
15	WE	62	F	0	1	8	1	1	5	1	0
16	N	63	F	5	1	1	1	1	5	1	0
17	N	66	F	2	1	1	1	1	3	1	1
18	WE	67	F	4	1	1	1	1	4	1	1
19	WE	79	F	3	1	1	1	1	2	1	0
20	WE	60	F	0	1	1	1	1	5	1	0
21	N	85	F	3	0	1	0	1	5	1	0
22	WE	65	M	5	1	1	1	1	3	1	0
23	N	69	F	5	1	1	0	1	5	1	0
24	WE	69	F	0	1	1	1	1	4	1	0

N = nutrition education; WE = walking exercise; F= female; M = male; fv = fruits and vegetables; m/dk = missing/do not know

Baseline Nutrition Data

#	Group	Age	Sex	fv139	fv140	fv141	fv142	fv143	fv144	fv145	fv146
1	N	74	F	1	1	1	1	0	1	0	1
2	N	79	F	1	1	1	1	1	1	1	1
3	N	67	M	0	1	0	0	0	1	0	1
4	WE	65	M	1	1	1	1	1	1	1	1
5	N	73	F	1	1	1	1	1	1	1	1
6	N	77	F	1	1	1	1	1	1	1	1
7	WE	65	F	1	1	1	1	1	1	1	1
8	N	74	F	1	1	1	1	1	1	1	1
9	N	77	F	1	1	1	1	1	1	1	1
10	WE	60	F	1	1	1	1	1	0	1	1
11	WE	73	F	1	1	1	1	1	1	1	1
12	WE	74	F	1	1	1	1	1	1	1	1
13	WE	84	F	0	1	1	1	1	1	1	1
14	N	64	M	1	1	1	1	1	1	1	1
15	WE	62	F	1	1	1	1	1	1	1	1
16	N	63	F	1	0	1	1	1	1	1	1
17	N	66	F	0	1	1	1	1	1	1	1
18	WE	67	F	0	1	1	1	1	1	1	1
19	WE	79	F	1	1	1	1	1	1	1	1
20	WE	60	F	0	1	0	0	1	1	1	1
21	N	85	F	1	1	0	1	1	1	1	1
22	WE	65	M	1	1	1	1	1	1	1	0
23	N	69	F	1	1	1	1	1	1	1	1
24	WE	69	F	1	1	1	1	1	1	1	1

N = nutrition education; WE = walking exercise; F= female; M = male; fv = fruits and vegetables; m/dk = missing/do not know

Baseline Nutrition Data

#	Group	Age	Sex	fv147	fv148	fv149	fv150	fv151	fv152	fv153	fv154
1	N	74	F	1	1	1	1	1	1	0	0
2	N	79	F	1	1	1	1	1	0	0	1
3	N	67	M	1	1	1	0	1	1	0	0
4	WE	65	M	0	1	1	1	1	1	0	1
5	N	73	F	1	1	1	1	1	0	1	0
6	N	77	F	1	1	1	1	1	0	0	1
7	WE	65	F	1	0	1	1	1	0	0	0
8	N	74	F	1	1	1	1	1	1	0	1
9	N	77	F	1	1	1	0	1	0	0	0
10	WE	60	F	1	1	1	1	1	1	1	0
11	WE	73	F	1	1	1	1	1	0	0	0
12	WE	74	F	1	1	1	1	1	0	0	0
13	WE	84	F	1	1	1	1	1	1	0	0
14	N	64	M	1	1	0	1	1	0	0	1
15	WE	62	F	1	1	1	1	1	0	0	0
16	N	63	F	1	1	1	1	1	1	1	1
17	N	66	F	1	1	1	1	1	0	0	0
18	WE	67	F	1	0	1	0	1	0	0	0
19	WE	79	F	1	1	1	1	1	0	0	0
20	WE	60	F	1	1	1	1	1	0	0	0
21	N	85	F	1	1	1	1	1	0	0	0
22	WE	65	M	1	0	0	1	1	0	1	0
23	N	69	F	1	1	1	1	1	1	1	0
24	WE	69	F	1	1	1	1	1	0	0	0

N = nutrition education; WE = walking exercise; F= female; M = male; fv = fruits and vegetables; m/dk = missing/do not know

Baseline and Post Intervention Nutrition Data

#	Group	Age	Sex	fv155	fv156	fv207	fv208	fv209	fv210	fv211	fv212
1	N	74	F	1	0	m/dk	m/dk	6	5	5	2
2	N	79	F	1	1	m/dk	m/dk	0	m/dk	1	1
3	N	67	M	0	0	0	3	m/dk	0	3	m/dk
4	WE	65	M	1	0	2	0	1	1	2	2
5	N	73	F	1	0	1	0	5	14	0	3
6	N	77	F	0	1	6	3	2	4	2	4
7	WE	65	F	0	0	5	m/dk	2	2	2	2
8	N	74	F	1	0	2	3	m/dk	2	3	4
9	N	77	F	0	0	7	7	4	0	1	0
10	WE	60	F	0	0	0	6	2	2	1	0
11	WE	73	F	1	1	6	4	4	3	4	4
12	WE	74	F	1	0	7	2	2	6	5	2
13	WE	84	F	0	0	5	2	6	3	6	0
14	N	64	M	0	0	3	0	0	4	2	0
15	WE	62	F	0	0	1	1	1	0	1	1
16	N	63	F	1	1	m/dk	m/dk	2	0	1	1
17	N	66	F	0	1	1	1	0	1	4	2
18	WE	67	F	0	1	m/dk	1	0	1	7	m/dk
19	WE	79	F	0	1	7	0	2	3	0	2
20	WE	60	F	1	0	0	0	2	0	4	0
21	N	85	F	0	1	2	1	1	1	3	0
22	WE	65	M	1	1	7	0	1	1	4	m/dk
23	N	69	F	1	1	m/dk	m/dk	2	0	6	m/dk
24	WE	69	F	1	1	6	4	2	3	2	2

N = nutrition education; WE = walking exercise; F= female; M = male; fv = fruits and vegetables; m/dk = missing/do not know

Post Intervention Nutrition Data

#	Group	Age	Sex	fv213	fv214	fv215	fv216	fv217	fv218	fv219	fv220
1	N	74	F	4	0	5	0	6	1	1	1
2	N	79	F	2	m/dk	1	m/dk	2	1	1	0
3	N	67	M	7	m/dk	1	m/dk	0	0	3	m/dk
4	WE	65	M	3	3	0	2	1	0	0	0
5	N	73	F	3	2	0	0	2	1	0	1
6	N	77	F	6	5	4	2	3	2	4	1
7	WE	65	F	m/dk	2	0	0	2	2	m/dk	0
8	N	74	F	4	3	2	1	6	1	1	0
9	N	77	F	0	0	3	0	1	0	0	1
10	WE	60	F	5	0	4	0	1	2	4	0
11	WE	73	F	3	3	3	0	6	2	1	2
12	WE	74	F	2	0	0	0	0	4	7	4
13	WE	84	F	3	2	3	1	6	1	2	1
14	N	64	M	1	2	4	0	4	3	0	4
15	WE	62	F	0	0	1	0	1	0	0	0
16	N	63	F	m/dk	1	1	0	7	0	m/dk	0
17	N	66	F	3	4	3	3	4	1	1	3
18	WE	67	F	0	m/dk	0	4	2	2	2	m/dk
19	WE	79	F	3	3	2	0	1	0	0	3
20	WE	60	F	0	0	4	0	1	2	2	2
21	N	85	F	3	4	1	1	2	3	3	3
22	WE	65	M	4	1	1	1	3	3	1	2
23	N	69	F	0	1	4	1	7	1	0	1
24	WE	69	F	2	3	1	3	5	0	m/dk	2

N = nutrition education; WE = walking exercise; F= female; M = male; fv = fruits and vegetables; m/dk = missing/do not know

Post Intervention Nutrition Data

#	Group	Age	Sex	fv221	fv222	fv223	fv224	fv225	fv226	fv227	fv228
1	N	74	F	2	5	6	5	m/dk	5	5	3
2	N	79	F	1	0	1	m/dk	1	2	1	4
3	N	67	M	m/dk	7	5	m/dk	m/dk	7	m/dk	3
4	WE	65	M	1	2	1	0	2	1	1	3
5	N	73	F	2	2	5	3	1	14	0	2
6	N	77	F	3	2	4	4	1	5	1	3
7	WE	65	F	0	m/dk	3	2	m/dk	6	0	0
8	N	74	F	1	3	5	1	3	4	7	0
9	N	77	F	0	0	0	0	0	4	3	1
10	WE	60	F	0	5	6	6	2	6	5	0
11	WE	73	F	2	1	4	1	0	3	0	2
12	WE	74	F	2	0	3	7	2	7	m/dk	2
13	WE	84	F	5	1	3	6	5	1	6	6
14	N	64	M	2	4	6	1	1	14	0	0
15	WE	62	F	1	0	5	3	1	5	1	0
16	N	63	F	1	0	7	7	0	7	0	0
17	N	66	F	4	3	4	1	4	2	1	3
18	WE	67	F	3	2	2	2	0	.	0	3
19	WE	79	F	3	4	7	2	3	7	0	4
20	E	60	F	2	4	3	0	2	3	3	0
21	N	85	F	2	2	2	0	1	2	1	3
22	WE	65	M	3	2	4	0	2	3	0	1
23	N	69	F	0	3	7	m/dk	7	7	0	0
24	WE	69	F	1	2	6	2	m/dk	2	m/dk	3

N = nutrition education; WE = walking exercise; F= female; M = male; fv = fruits and vegetables; m/dk = missing/do not know

Post Intervention Nutrition Data

#	Group	Age	Sex	fv229	fv230	fv231	fv232	fv233	fv234	fv235	fv236
1	N	74	F	4	6	6	1	1	1	1	5
2	N	79	F	2	2	1	0	1	1	1	4
3	N	67	M	m/dk	14	14	8	8	8	1	8
4	WE	65	M	1	1	3	1	1	1	1	3
5	N	73	F	14	2	2	1	1	1	1	5
6	N	77	F	6	1	2	1	1	1	1	1
7	WE	65	F	1	2	1	1	1	1	1	5
8	N	74	F	4	1	0	1	1	1	1	5
9	N	77	F	4	3	1	1	1	1	1	5
10	WE	60	F	1	6	0	1	1	1	1	5
11	WE	73	F	0	0	0	1	1	1	1	5
12	WE	74	F	2	0	0	8	8	1	1	3
13	WE	84	F	6	1	6	1	1	1	1	5
14	N	64	M	7	0	4	1	1	0	1	2
15	WE	62	F	4	1	0	1	1	1	1	5
16	N	63	F	0	3	2	1	1	1	1	5
17	N	66	F	2	3	4	1	1	1	1	5
18	WE	67	F	0	1	3	1	1	1	1	5
19	WE	79	F	0	2	3	1	1	1	1	5
20	WE	60	F	6	3	0	1	1	1	1	5
21	N	85	F	2	3	3	1	1	1	1	5
22	WE	65	M	3	0	0	1	1	1	1	3
23	N	69	F	14	0	2	1	1	1	1	5
24	WE	69	F	6	1	0	1	1	1	1	4

N = nutrition education; WE = walking exercise; F= female; M = male; fv = fruits and vegetables; m/dk = missing/do not know

Post Intervention Nutrition Data

#	Group	Age	Sex	fv237	fv238	fv239	fv240	fv241	fv242	fv243	fv244
1	N	74	F	0	0	1	1	1	1	1	1
2	N	79	F	0	0	1	1	0	0	1	0
3	N	67	M	0	0	8	0	0	0	0	1
4	WE	65	M	0	0	1	n/a	n/a	n/a	n/a	n/a
5	N	73	F	1	1	1	1	0	1	1	1
6	N	77	F	1	1	1	1	1	1	1	1
7	WE	65	F	1	0	1	n/a	n/a	n/a	n/a	n/a
8	N	74	F	1	1	1	1	1	1	1	1
9	N	77	F	1	0	1	1	0	1	1	1
10	WE	60	F	0	0	1	n/a	n/a	n/a	n/a	n/a
11	WE	73	F	1	1	1	n/a	n/a	n/a	n/a	n/a
12	WE	74	F	0	0	1	n/a	n/a	n/a	n/a	n/a
13	WE	84	F	0	0	1	n/a	n/a	n/a	n/a	n/a
14	N	64	M	1	0	8	1	1	1	1	0
15	WE	62	F	0	0	1	n/a	n/a	n/a	n/a	n/a
16	N	63	F	1	1	1	1	1	1	1	1
17	N	66	F	1	1	1	1	1	1	1	1
18	WE	67	F	0	0	8	n/a	n/a	n/a	n/a	n/a
19	WE	79	F	1	1	1	n/a	n/a	n/a	n/a	n/a
20	WE	60	F	1	0	1	n/a	n/a	n/a	n/a	n/a
21	N	85	F	1	1	1	1	1	1	1	1
22	WE	65	M	0	0	1	n/a	n/a	n/a	n/a	n/a
23	N	69	F	0	0	1	1	1	1	1	1
24	WE	69	F	8	8	1	n/a	n/a	n/a	n/a	n/a

N = nutrition education; WE = walking exercise; F= female; M = male; fv = fruits and vegetables; n/a = not applicable

Post Intervention Nutrition Data

#	Group	Age	Sex	fv245	fv246	fv247	fv248	fv249
1	N	74	F	1	0	1	5	8
2	N	79	F	1	1	1	4	8
3	N	67	M	0	0	0	2	8
4	WE	65	M	n/a	n/a	n/a	n/a	n/a
5	N	73	F	1	1	1	4	8
6	N	77	F	1	1	1	5	8
7	WE	65	F	n/a	n/a	n/a	n/a	n/a
8	N	74	F	1	1	1	5	8
9	N	77	F	1	0	1	4	8
10	WE	60	F	n/a	n/a	n/a	n/a	n/a
11	WE	73	F	n/a	n/a	n/a	n/a	n/a
12	WE	74	F	n/a	n/a	n/a	n/a	n/a
13	WE	84	F	n/a	n/a	n/a	n/a	n/a
14	N	64	M	1	1	1	4	8
15	WE	62	F	n/a	n/a	n/a	n/a	n/a
16	N	63	F	1	1	1	5	8
17	N	66	F	1	1	1	5	8
18	WE	67	F	n/a	n/a	n/a	n/a	n/a
19	WE	79	F	n/a	n/a	n/a	n/a	n/a
20	WE	60	F	n/a	n/a	n/a	n/a	n/a
21	N	85	F	1	1	1	5	8
22	WE	65	M	n/a	n/a	n/a	n/a	n/a
23	N	69	F	1	1	1	4	8
24	WE	69	F	n/a	n/a	n/a	n/a	n/a

N = nutrition education; WE = walking exercise; F= female; M = male; fv = fruits and vegetables; n/a = not applicable

Baseline and Post Intervention Leg Power Data

#	Group	Age	Sex	Baseline Leg Power (Watts)		Post Intervention Leg Power (Watts)	
				Right	Left	Right	Left
1	N	74	F	90.1	88.9	91.4	95
2	N	79	F	69.9	58	76	71.7
3	N	67	M	55.4	68	86	78.2
4	WE	65	M	155	170.3	157.8	168.2
5	N	73	F	41.4	51.1	65.3	75.5
6	N	77	F	46.4	57.2	45.6	39
7	WE	65	F	92.7	70.2	105.4	87.3
8	N	74	F	61.3	58.9	59.9	50.4
9	N	77	F	101.1	100.3	103.4	100.5
10	WE	60	F	98	103.5	109	125.2
11	WE	73	F	64.4	58.4	99.5	105.2
12	WE	74	F	90	118	101.9	97.2
13	WE	84	F	101.1	90	106.5	99.4
14	N	64	M	156.9	142.8	167.1	168.7
15	WE	62	F	130.8	124.2	150.8	155
16	N	63	F	62.4	56.2	60.2	54.6
17	N	66	F	46.8	48.7	47.1	50.2
18	WE	67	F	67.8	60.7	77.9	72.3
19	WE	79	F	48.4	56.2	59.3	68.9
20	WE	60	F	120	128.3	160.9	180.4
21	N	85	F	27.3	34.2	21.4	30.1
22	WE	65	M	185.8	135.4	211.8	163.9
23	N	69	F	142.8	140.9	140.9	138.7
24	WE	69	F	67.5	63.1	70.3	68.5

N = nutrition education; WE = walking exercise; F= female; M = male