AN ABSTRACT OF THE THESIS OF

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Title: Effect of a Functional-Based Training Program on the Performance of Instrumental Activities of Daily Living Among Older Adults Residing in Retirement Communities

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Sustaining an older adult's ability to live independently is a very important goal of geriatrics and gerontology. The extent to which an individual can live independently depends on his or her ability to perform Instrumental Activities of Daily Living. Impairments in the physical domains of muscle strength, flexibility, endurance, and neuromuscular control are often responsible for the inability to carry out these Instrumental Activities of Daily Living. Therefore, research has typically focused on administering interventions to older adults to mitigate or delay impairments in the physical domains in hopes that the older adults would subsequently improve functional ability and maintain independence. The effect these types of exercise interventions have on improving function is not clear. Because living independently requires an individual to carry out daily functional tasks without assistance, given the Principal of Specificity, an exercise program composed of these functional tasks would be the most specific and efficient way to improve the functional abilities of older adults. The aim of this study was to determine the effect a

novel functional based training program would have on older adults' ability to perform Instrumental Activities of Daily Living.

A total of 14 individuals (mean age 82 ± 4 yrs) participated in this study. All participants took part in a 10 wk control period followed by a 10 wk functional based training program. The LIFE (Living Independently through Functional Exercise) training program consisted of a multi-station circuit with nine different activity stations mimicking functional tasks. The stations included, sit-to-stand, stair climbing, laundry, grocery shopping, vacuuming, sweeping, putting on and removing a jacket, pulling a suitcase, and getting down and up from the floor. Participants were tested before and after the control period and after the training program. The tests included the Physical Performance Test and the Physical Functional Performance –10 to measure the ability to perform Instrumental Activities of Daily Living and the Senior Fitness Test to evaluate the physical domains of strength, flexibility, endurance and dynamic balance.

A repeated-measures ANOVA revealed that there were no significant differences on any test scores during the control period except for lower extremity flexibility of the Senior Fitness Test. After the training period, improvements ranging from 10-40% ($p < 0.05$) were seen on all tests of the Physical Performance Test, the Physical Functional Performance –10, and on the chair stands, endurance walk, and arm curl of the Senior Fitness Test. After conversion to standard scores, paired t-tests revealed that the magnitude of change in the Physical Performance Test (0.58 ± 0.15) and the Physical Functional Performance-10 (0.69 ± 0.11) was significantly greater ($p < 0.05$) than the magnitude of change in the Senior Fitness Test ($0.10 \pm .08$). The regression analysis revealed a positive relationship between improvements in the Physical Functional Performance-10 and the Senior Fitness Test scores following the training program ($p = 0.002$, $R^2 = 0.605$). For every unit of change in the Physical Functional Performance-10 standard score there was only half as much of an increase in the Senior Fitness Test standard score. There was not a significant relationship between the Physical Performance Test and the Senior Fitness Test.

Our results support the hypothesis that this novel functional-based training program was able to facilitate improvements in a broad spectrum of functional measures among frail older adults. Furthermore, consistent with the Principle of Specificity, improvements in function were significantly greater than improvements in fitness. This program offers an alternative to traditional exercise programs for this population.

Effect of a Functional-Based Training Program on the Performance of Instrumental Activities of Daily Living Among Older Adults Residing in Retirement Communities

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I understand that my thesis will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my thesis to any reader upon request.

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Jessica Carmona, Author

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CONTRIBUTION OF AUTHORS

Jessica Carmona collaborated on generating the initial ideas for this study and writing a grant to fund the project. She was primary in learning the testing procedures and overseeing accuracy of data collection. She helped train the research assistants, collaborated with development and design of the LIFE training program, and collaborated on data analysis and interpretation of results. She was the principle author of all components of this thesis.

Dr. Karen White collaborated on generating the initial ideas for this study and writing a grant to fund the project. She was primary in developing the testing laboratory and training the research assistants. She assisted with data collection, development and design of the LIFE training program, data analysis and interpretation, and the editing of Chapters 1-3.

Dr. Kathy Gunter collaborated on initial ideas and refinement of study design and assisted with data analysis and interpretation.

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CHAPTER ONE: INTRODUCTION

Background

In the United States today there are nearly two million persons (mean age 84 yr) living in long-term care facilities; generally because they are no longer able to care for themselves. In addition, for every resident of a long-term care facility there are at least two older adults with similar functional limitations who live in the community (Suzman, Willis, & Manton, 1992), typically requiring help and support from family and friends to meet their personal needs. As our society ages, it seems inevitable that there will be more and more older adults who are frail and unable to take care of themselves. In fact, with United States residents over the age of 85 being the fastest growing segment of the population, by the year 2040 there is expected to be a fivefold increase in the number of elderly nursing-home residents and functionally dependent individuals in the community (Suzman et al., 1992). The cost of living in a nursing home is approximately $40,000/year today and is expected to increase to $97,000/year by 2030 (Long Term Preferred Care). The total cost for nursing home care in the U.S. is $87 billion with only $44.9 billion of that being paid for by insurance (Long Term Preferred Care). This, in turn, leaves over half the burden of nursing home costs falling on individuals and their families. Given these projections in population and nursing home costs, there will be approximately $1.16 trillion/year spent on nursing home care in 2040. Over the next 40 yr, if there was a way to help these older adults maintain their independence and delay admission into a nursing home by even one year, there would be a savings of $624 billion.

Aging is associated with declines in many physical domains including strength, balance, flexibility, reaction time, coordination, and muscular and cardiovascular endurance (Spirduso, 1995). Reductions in these physical domains are, in turn, a major determinant of loss of function in later life. Specifically, there is a decline in the ability to independently accomplish Instrumental Activities of Daily Living. Instrumental Activities of Daily Living encompass an individual's ability to maintain a safe and effective household, including preparing meals, shopping, taking medication, managing money, using the telephone, performing heavy chores and light housekeeping, transportation, and laundry (Spirduso, 1995). The extent to which an individual can live independently depends on his or her ability to perform these basic tasks (Shephard, 1990). It is estimated that by the year 2040, 13.1 million persons in the community will have at least one limitation in the Instrumental Activities of Daily Living (Suzman et al., 1992). This limitation in Instrumental Activities of Daily Living is what can eventually force an individual to move into a long-term care facility. Therefore, maintaining independent living by sustaining an individual's ability to perform the Instrumental Activities of Daily Living is one of the major goals of geriatrics and gerontology. Research shows that there is a strong relationship between regular physical activity and independent living, with low physical activity levels and a sedentary lifestyle being a predictor of functional decline with aging (Spirduso & Cronin, 2001). Therefore, appropriate physical activity intervention is thought to prevent and even reverse much of this loss in Instrumental Activities of Daily Living performance (Rikli & Jones, 1999a).

The inability to perform activities of daily living is what sociologist Saad Nagi refers to as a disability in his Disablement Model (Verbrugge & Jette, 1994). Specifically, according to Nagi, a disability is a "limitation in performance of socially defined activities and roles expected of individuals within a social and physical environment." This coined term "disability" is the last in a hierarchy of outcomes in Nagi's Disablement Model. Through four central concepts, this model describes the pathway leading to disability. The first concept is pathology, which refers to "biochemical and physiological abnormalities that are detected and medically labeled as disease, injury or congenital/developmental conditions." Next in the hierarchy is impairment. Impairments are "dysfunctions and significant structural abnormalities in specific body systems." This refers to dysfunctions in the physical domains of muscle strength, range of motion or flexibility, maximum oxygen uptake, body composition, and neuromuscular control. The third outcome, which is a result of impairment, is functional limitation. This is restriction in basic physical and mental actions such as walking, reaching, stooping, climbing stairs and producing intelligible speech. Finally, these functional limitations can lead to the fourth concept of disability. The progression of Nagi's model indicates that disability originates from disease or disuse, with disease leading to impairment, impairment to functional limitation, and functional limitation to disability (Rikli & Jones, 1999a; Verbrugge & Jette, 1994).

Due to this link between impairment, functional limitation, and disability, research has focused on administering exercise interventions to older adults aimed at improving an individual at the impairment level in hopes that it would subsequently improve function and prevent disability. There is no doubt that exercise can have a positive effect on impairments in the physical domains of muscle strength, flexibility, balance and cardiovascular fitness. For example, there were observed gains in strength of approximately 174% in institutionalized older adults aged 90 yr or more who participated in an 8 wk strength training program at 80% of maximum intensity (Fiatarone et al., 1990). Shaw and Snow (1998) reported significant increases in balance, lower-body muscular strength, muscular power, and leg lean mass in post-menopausal woman who performed weight-bearing exercises for nine months three days/week. Similarly, individuals (mean age 80) improved balance performance to the level of an individual 3 to 10 yr younger and significantly increased isokinetic strength after taking part in a 3 month intensive balance and lower body strength training program (Wolfson et al., 1996).

While there is ample scientific evidence on the positive effects these impairment level exercise programs have on minimizing impairments, existing scientific evidence is less clear as to the carry over effect these same types of exercise programs have on minimizing loss in function and preventing disability. For example, Buchner et al. (1997) found that a 24-26 wk strength training and/or endurance training program had no effect on measures of function in adults aged 68-85 yr despite improvements in strength and endurance. Similarly, Skelton, Young, Greig, & Malbut (1995) found that a 12 wk progressive resistance training program for women 75 yr and older improved strength and power of the knees, arms, and legs, but had a very limited effect on the ability to rise from a chair, lift a bag onto a surface, rise from the floor, and climb steps and curbs. Consistent with this, a proprioceptive neuromuscular facilitation exercise intervention for residents of an assisted-living facility (Klein, Stone, Phillips, Gandi, & Hartman, 2002) was able to improve range of motion in the shoulder and ankle but had no impact on the Timed Up-and-Go test, a common measure of function. These studies concentrated on just one or two physical domains in their exercise program and while they found improvements in the physical domain involved in the exercise program, there was little or no carry over to function or independence.

In contrast, studies involving multi-component exercise interventions that focus on many physical domains have documented significant carry over to function among older adults. One particular multi-component exercise intervention (Worm, Vad, Puggaard, Stovring, & Kragstrup, 2001) examined 22 older adults over 74 yr of age who participated in a 60 min exercise program consisting of flexibility training, aerobics, rhythm, balance and reaction exercises, and muscle training (strength and endurance). This intervention took place twice a week for 12 wk. Function was assessed using the Berg Balance Scale (Berg, Wood-Dauphinee, Williams, & Gayton, 1989) and the SF-36 (Ware & Sherbourne, 1992), a self-reported measure of function. After 12 wk, the exercise group had significantly greater increases on both of these functional measures compared to the control group. In a very similar program (Brown et al., 2000) involving flexibility, balance, body handling skills, reaction speed, coordination, and strength, 48 frail individuals (mean age 83 yr) significantly improved on the Physical Performance Test (Reuben and Siu, 1990). Lazowski et al. (1999) attempted to determine the effects of a functional fitness training program consisting of progressive strength, balance, flexibility, and endurance training on the functional ability of long term care residents. Sixty-eight residents were randomized into either the functional fitness training program or a seated range of motion program. The functional fitness training program included progressive strength, balance, flexibility, and endurance training. The range of motion program consisted of seated range of motion exercises for the fingers, hands, arms, knees, and ankles. Both programs were conducted for 45 min, three times per week for 4 months. Using the Timed Up and Go (Podsiadlo & Richardson, 1991) and Functional Independence Measure (Keith, Granger, Hamilton, & Sherwin, 1987) as the functional measures, results indicated the functional fitness training group improved on the Timed Up and Go test and maintained their Functional Independence Measure scores. The group that participated in the range of motion program produced significantly deteriorated Functional Independence Measure scores following the intervention.

These studies demonstrate that with the goal of improved function, a study's outcome seems to depend on the exercise program administered. Those individuals who used a more comprehensive exercise program in their study that challenged multiple physical domains were able to demonstrate improvements in function. However, those who used a more basic exercise program focusing on only one or two physical domains were not able to show improvements in function.

A possible explanation for these findings can be attributed to a key underlying concept of training known as the Principle of Specificity (Brooks, Fahey, White, & Baldwin, 2000). This refers to the idea of overloading movements that are as similar as possible to those movements that wish to be improved. The ability to perform daily activities such as doing the laundry and making the bed are not limited to a single physical domain but rather involve a combination of domains such as strength, balance, endurance, reaction time, and coordination. This concept of specificity is illustrated by Cress et al. (1999) who investigated whether an endurance and strength training program would improve function. While this program improved functional tasks that required endurance and strength, it did not improve functional tasks that required balance, coordination, and upper body flexibility since the program was not specifically designed to improve balance, coordination, and upper body flexibility.

Because more comprehensive exercise studies touch on more of the physical domains needed to complete a functional task, they show more promising results. However, it is possible to be even more specific with training if improved functional performance is the desired outcome. If the goal is to increase an older adult's ability to independently carry out activities of daily living then given the Principle of Specificity, it seems reasonable that an exercise program composed of functional tasks would be the most specific and efficient way to obtain the desired outcomes. To our knowledge there is only one other study that has used such an exercise program to improve functional performance in older adults (de Vreede, Samson, van Meeteren, Duursma, & Verhaar, 2004). They had 98 community-living women aged 70 and older engage in a functional based exercise program 3 times a week for 12 wk. At each workout they participated in a progressive program that simulated many common activities of daily living. The results of that study revealed that the functional task exercise program was able to significantly improve function among the exercisers relative to the control group.

Rationale

Sustaining an older adult's ability to live independently is a major goal of geriatrics and gerontology. Living independently requires an individual to carry out daily functional tasks without assistance. Research does not fully support the assertion that impairment level exercise programs that focus on improving the physical domains are an effective means of improving function and promoting independence in later life. Although more comprehensive impairment-based programs seem to be more successful than those focusing on a single physical domain, it may be possible to be even more effective with an exercise program. Given the Principle of Specificity, a progressive exercise program composed of common functional tasks that mimic the Instrumental Activities of Daily Living should lead to the greatest improvements in this area by having participants practice the specific tasks that need to be improved.

The purpose of this study is to determine the effect of a novel functional-based training program on the ability to perform Instrumental Activities of Daily Living among older adults residing in retirement-communities.

Hypotheses

Hypothesis #1:

It is hypothesized that there will be greater improvements on tests of Instrumental Activities of Daily Living (i.e. Physical Performance Test, Physical Functional Performance-10) after the training period compared to after the control period.

Hypothesis #2:

It is hypothesized that upon conclusion of the training period, improvement on tests of Instrumental Activities of Daily Living (i.e. Physical Performance Test, Physical Functional Performance-10) will exceed improvements in the underlying physical domains (i.e. Senior Fitness Test).

CHAPTER TWO:

Effect of a Functional-Based Training Program on the Performance of Instrumental Activities of Daily Living Among Older Adults Residing in Retirement Communities

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Abstract

The purpose of this study was to determine the degree to which a functional-based training program would improve the ability of older adults to perform IADLs. Fourteen individuals (mean age 82) took part in a 10 wk control period followed by a 10 wk functional-based training program. Tests used were the Senior Fitness Test (SFT), the Physical Performance Test (PPT), and the Physical Functional Performance–10 (PFP-10). After the training period, improvements ranging from 10-40% ($p<.05$), were seen on all tests of the PPT, and PFP-10, and on three items of the SFT. After conversion to standard scores, the magnitude of change in the PPT and the PFP-10 was significantly greater ($p< 0.05$) than the magnitude of change in the SFT. These data support that this novel functional-based training program was able to facilitate improvements in a broad spectrum of functional measures among frail older adults.

Introduction

The number of older adults living in the United States is growing rapidly, with those over the age of 85 yr being the fastest growing segment of the population. There are nearly two million persons (mean age 84 yr) living in long-term care facilities in the U.S.; generally because they are no longer able to care for themselves (Suzman, Willis, & Manton, 1992). By the year 2040 there is expected to be a fivefold increase in the number of nursing-home residents (Suzman et al., 1992). The cost of living in a nursing home is approximately $40,000/year today and is expected to increase to $97,000/year by 2030 (Long Term Preferred Care). The total cost for nursing home care in the U.S. is $87 billion with only $44.9 billion of that being paid for by insurance. This, in turn, leaves about half the burden of nursing home costs falling on individuals and their families (Long Term Preferred Care). Given these projections in population and nursing home costs, there will be approximately $1.16 trillion/year spent on nursing home care in 2040. Over the next 40 yr, if there was a way to help these older adults maintain their independence and delay admission into a nursing home by even 1 yr, there would be a savings of $624 billion. Therefore, on an economic as well as humanitarian basis, sustaining an older adult's ability to live independently is a very important goal of geriatrics and gerontology.

The extent to which an individual can live independently depends on his or her ability to perform daily functional tasks known as the Instrumental Activities of Daily Living. Instrumental Activities of Daily Living are the tasks an individual does to maintain a safe and effective household (Klein, Stone, Phillips, Gandi, & Hartman 2002). Limitations in the ability to perform Instrumental Activities of Daily Living can eventually lead to loss of independence and the possibility of moving into a long-term care facility. It is estimated that by the year 2040, 13.1 million persons in the United States will have a limitation in at least one Instrumental Activity of Daily Living (Suzman et al., 1992).

Impairments in the physical domains of muscle strength, flexibility, endurance, and neuromuscular control are often responsible for the inability to carry out functional tasks such as the Instrumental Activities of Daily Living (Verbrugge & Jette, 1994). Therefore, research has typically focused on administering interventions to older adults to mitigate or delay impairments in the physical domains in hopes that the older adults would subsequently improve functional ability and maintain independence. There is ample scientific evidence on the positive effects traditional exercise training programs have on improving strength, flexibility, and endurance. It is less clear as to the effect these same types of training programs have on improving function. For example, Buchner et al. (1997) found that strength training and/or endurance training did not improve measures of function in adults 68-85 yr despite improvements in strength and endurance. The ability to perform the Instrumental Activities of Daily Living is not limited to a single physical domain but rather involves a combination of domains. Therefore training programs that challenge many physical domains tend to show more promising results. For example, Brown et al. (2000) showed that a training program involving many physical domains (i.e., strength, balance, flexibility, coordination and reaction speed) did improve measures of function among frail older adults. However, it may be possible to improve functional performance to an even greater extent through a more targeted training program. Given the Principle of Specificity (Brooks, Fahey, White, & Baldwin, 2000), an exercise program composed of common functional tasks that mimic Instrumental Activities of Daily Living should lead to the greatest improvement in this area since participants train by doing the specific tasks they desire to improve. A recent study by de Vreede et al (2004) supports this Principle as they were able to induce greater improvements in functional performance among community based women who participated in a functional training program compared to those in a traditional strength training program. The purpose of this study was to provide further evidence of the positive effect a functional-based training program can have on the ability to perform Instrumental Activities of Daily Living among older adults residing in retirement communities.

Methods

Participants

Men and women were recruited to participate in this study from two local retirement communities through flyers and informational talks. In order to participate in this study, participants had to be over the age of 70 yr. Participants also had to be ambulatory with or without the use of a cane. If an individual was unable to follow directions or complete the baseline testing due to physical or cognitive impairments, he or she was excluded from the study. Participants also had to receive medical clearance from their physician to participate in the training program. Those participants included in the study acted as their own controls by taking part in a 10 wk control period followed by the 10 wk functional-based training program. This study was approved by the Oregon State University Institutional Review Board for the protection of human subjects (see Appendix B), and all subjects signed a written informed consent form prior to testing (see Appendix C).

Instruments

Physical Performance Test

The Physical Performance Test was used to measure the participants' functional performance doing usual daily activities, including both Basic and Instrumental Activities of Daily Living (Reuben & Siu, 1990). The Basic Activities of Daily Living are the self-care skills that an individual performs to maintain health and hygiene. This includes dressing, bathing, toileting, grooming, getting in and out of bed or chairs, locomoting, and eating (DeVries, 1997). For the purposes of this study, the seven-item Physical Performance Test was used and involved the following tasks:

writing a sentence, simulating eating, donning and doffing a jacket, turning 360 degrees while standing, lifting a book onto a shelf, picking up a penny from the floor, and walking 50 ft. Scoring for these items was based on the time it took to complete the task. Per a standardized protocol, time was converted to a 0-4 scale. Overall scores could range from 0-28 with a higher score representing better performance. Please refer to Appendix D for the point system and the qualitative guidelines for scoring. Previous research has deemed the Physical Performance Test to be a reliable test (Cronbach's alpha = 0.87) and a valid measure of physical performance for community-dwelling older adults over the age of 65 yr with a concurrent validity coefficient of 0.80 when compared to accepted functional status assessments (Reuben & Siu, 1990).

Physical Functional Performance-10

The Physical Functional Performance-10 is a shorter, more portable version of the Continuous-Scale Physical Functional Performance Test (Cress, Buchner, Questad, Essleman, deLateur & Schwartz, 1996). The Physical Functional Performance-10 is an in-depth measure of function using ten everyday tasks fundamental to independent living (Cress, Petrella, Moore, & Schenkman, 2003). The tasks are ordered from easiest to most difficult. The low difficulty tasks include: carrying a weighted pot a distance of one meter, donning and doffing a jacket, and placing and removing a sponge from an adjustable shelf. The moderate difficulty tasks include: sweeping the floor with broom and dustpan, transferring clothes from a washer to a dryer and then from the dryer to a basket, and picking up four scarves from the floor. Finally, the high difficulty tasks include: carrying groceries 70 m, walking for 6 min, sitting down and standing up from the floor, and climbing stairs. The participants were instructed to complete as many tasks as possible. They were encouraged to perform each task safely but to work at their maximal perceived effort. Scoring for each task was determined by the time taken to complete the task, the weight carried, and/or the distance traveled. Scores were grouped into subscale scores representing five physical domains (i.e. upper and lower body strength, flexibility, balance, coordination, and endurance). The five subscales scores were averaged to determine the total score. A higher score represents better performance. Please refer to Appendix E for the Physical Functional Performance-10 item data sheet. The Physical Functional Performance-10 took approximately 30 min to administer. Cress et al. (2003) have demonstrated that the Physical Functional Performance-10 is reliable, valid, and sensitive to change.

Senior Fitness Test

The Senior Fitness Test was used to assess the physical domains of strength, endurance, balance, and flexibility (Rikli & Jones, 1999a). The specific test items include: a 30 sec chair stand to assess lower body strength, a thirty second arm curl to assess upper body strength, the 6-min walk test for aerobic endurance, the chair sit-and-reach for lower body flexibility, the back scratch to assess upper body flexibility, and the 8-ft up-and-go to assess dynamic balance. The 30 sec chair stand is the number of full stands that can be completed in 30 sec with arms folded across chest. The arm curl test is the number of bicep curls that can be completed in 30 sec holding a hand weight (5 lb for women and 8 lb for men). This is performed on the participants' dominant side only with the palm turned up as the weight is raised. The

6-min walk test is the amount of distance that can be covered in a 6-min period at a self-selected pace. Rest breaks are allowed as needed. The score is the total distance covered in 6 min. For the chair sit-and reach, the participant is in a seated position at the front of a chair with one leg extended and hands reaching, one over the other, toward the toes. The number of inches (plus or minus) between extended fingers and tip of toe is recorded. Finally, the back scratch is performed with one hand reaching over the shoulder and one up the middle of the back. The number of inches between the extended middle fingers (plus or minus) is recorded. The 8-ft up-and-go measures the number of seconds required to get up from a seated position, walk 8 ft, turn, and return to a seated position. Each item is scored separately and can be compared to normative standards that were developed from a national study of 7,000 independent-living men and women ages 60-94 yr throughout the United States (Rikli & Jones, 1999b). Please see Appendix F for this normal range of scores. Rikli and Jones (1999a) have shown that for community-dwelling adults aged 60 yr and older, this test has content validity established through literature review and expert opinion, concurrent validity correlation coefficients ranging from 0.73 - 0.83 when comparing each test item with an established criterion measure, and high test-retest reliability with intraclass correlation coefficients ranging from 0.80 - 0.98 for the test items.

Bone Research Laboratory Health History Questionnaire

This is a general questionnaire requesting information about past and current medical conditions, current medication and alcohol use, smoking history, routine daily activities, and amount of assistance needed to complete common household tasks. This is the same form the Bone Research Laboratory has been using with all studies related to older adults conducted over the past 5 yr. Information from the questionnaires was compiled for demographic purposes and is not related to the outcome of the study.

Testing Procedures

During the informational talks used for recruitment, the purpose of the study and the procedures of the experiment were explained. After the talks, individuals who expressed interest in participating were given more details about the study along with the date and time of the baseline testing. With the exception of the Physical Functional Performance-10, which was administered at Oregon State University, all testing and training was administered at the retirement community in which the participants reside. Testing was administered before and after the ten-week control period and after the 10-wk exercise intervention by the same research team members. Testing took a total of 1 to 2 hr and took place over the course of two days to allow for rest. The testing procedures were both explained and demonstrated to the potential participants. On the day of initial testing, all potential participants were given an informed consent to sign and were tested on the Physical Performance Test. They were then tested on the Senior Fitness Test, completed the OSU Bone Laboratory Health History Questionnaire, and signed a medical clearance form that was later mailed to their doctor. Three days following the first testing day, participants were tested on the Physical Functional Performance-10 test.

Interventions

Control Period

During the ten-week control period, participants received two to three social visits in order to sustain their interest in and familiarity with the study. The participants were asked not to change their daily routine during this control period. Medical clearance forms were sent out to the participants' physicians during this time. After the control period, participants were retested following the same schedule as before to determine their pre-intervention functional status.

Training Period

Participants took part in a 10-wk functional- based training program called LIFE (Living Independently through Functional Exercise). LIFE is a novel training program that consists of a multi-station circuit with nine different activity stations mimicking daily functional tasks. The training program was administered at the retirement community in which the participants' reside. Participants took part in the LIFE training program twice a week with at least two days of rest between sessions during the 10 wk. Three to four staff members were present during training sessions to provide proper supervision and motivation. Each station progressed in intensity throughout the 10 wk, and progression was based on each participant's individual tolerance. Each person began at a different station in the circuit and moved to the next station every 2 min. Once the task was completed at a particular station, the participant chose to rest for the remainder of the 2 min or to begin the task again. The goal at each station was to complete the task at least one time. When this goal was achieved on two consecutive training days, the participant progressed to the next intensity level for that station. Participants kept track of their individual progression on an exercise card. The program began and ended with a 5-10 min warm-up and cool-down consisting of gentle movements and dynamic and static stretching. The following is a description of each exercise station:

Station 1: Sit-to-Stand. This station began with participants sitting in a hard straight-back chair, then rising to standing then returning to sitting, with participants using their arms as little as possible. Participants began with sets of five chair stands, taking as much rest as needed between sets and then progressed in intensity levels to sets of six, sets of eight, sets of ten, etc., until the task could be done continuously for 2 min.

Station 2: Stair Climbing. This station involved stepping over two 6-in steps. Walking up and down both steps, turning around and doing the same thing on the way back completed one cycle. All participants were able to do this continuously at their own pace for the entire 2 min. To increase the intensity, participants increased their walking speed in order to complete more cycles. Once the participant was walking as fast as safely possible, further progression in intensity involved increasing the height of the step by 2 in.

Station 3: Laundry. This station involved picking up a laundry basket containing beanbags and a set amount of clothing from the top of a dryer, walking out 30 ft, and then back, and replacing the basket on top of the dryer. The participants then transferred the beanbags and clothes from the basket into the dryer one at a time. After this was completed, the participant removed the beanbags and the clothes from the dryer, put them back into the basket, and repeated the cycle. This task began with

5 lb of beanbags and four articles of clothing. Once the participant was able to complete this task in 2 min, he or she was encouraged to move faster in order to complete additional cycles. In addition, the number of beanbags progressively increased to make the basket heavier.

Station 4: Grocery shopping. This task involved transferring groceries from shelves into one or two grocery bags, carrying the bags 20 ft out and back, and then distributing the groceries back onto the shelves. Initially participants transferred 5 lb of grocery items from the shelves to the bags and back. Once the participant was able to complete this task in 2 min, they were encouraged to complete additional cycles. When the participant was walking as fast as safely possible, further progression in intensity involved increasing the amount of grocery items placed in the bags, thus making the bags heavier.

Station 5: Vacuuming. Participants began this task by pushing a vacuum back and forth perpendicular to a 10 ft line. Vacuuming to the end of the line and back completed one cycle. All participants were all able to vacuum for the entire two minutes at their own pace. To increase the intensity, participants were asked to vacuum faster in an attempt to complete more cycles within the 2 min. Once the participant was vacuuming as fast as safely possible, weight was added to the vacuum in 1 lb increments.

Station 6: Sweeping. This task involved sweeping a half-cup of kitty litter into a dustpan from a 4 ft by 3 ft taped area. Once this was completed, the participant scattered the kitty litter back throughout the prescribed area and completed the task again. The participant progressively increased the number of cycles of completing this task without resting.

Station 7: Dressing. This task involved the participant putting on and taking off a series of three jackets. The jackets progressively increased in complexity from a zipper, to large buttons, to small buttons. Once the participant was able to put on and take off all three jackets within the 2 min, the participant only used the hardest, most complex jacket, donning and doffing it as many times as possible within the allotted time.

Station 8: Traveling. At this station, the participant pulled a rolling suitcase filled with 30 lb of weight around the perimeter of a room. Walking all the way around the room completed one cycle. Participants were all able to pull the suitcase for the entire 2 min at their own pace. To increase the intensity, participants were asked to walk faster in order to complete more cycles. Once the participant was walking as fast as safely possible, additional weight was added to the suitcase in 10 lb increments.

Station 9: Recovering from a fall. Participants lowered themselves onto their hands and knees (on a mat) and then got back up. Participants were instructed on how to do this task safely and initially were allowed to use a sturdy chair and the help of a spotter to rise from the floor. As the participants progressed, less assistance was needed. Once the participants could complete this task independently within the 2 min period, they were asked to do the task repeated times. For those who could not complete the task safely, sets of squats or lunges were done instead.

Statistical Analysis

SPSS version 11.0 was used for data analysis (Green & Salkind, 2003). Data were cleaned and double-checked for violations of the assumptions of normality, linearity and homogeneity of variance, as well as accuracy of data entry. Descriptive statistics were conducted to compute group means and standard deviations. To test hypothesis #1, a Repeated Measures Analysis of Variance was used to compare changes in the functional tests scores from the pre to post control period relative to changes from the post control period to post intervention. To detect a statistically significant difference in means over time at a power level of 0.80 and an alpha level of 0.05, at least 17 subjects are required (Kirk, 1982). To safely account for an expected 10% drop out rate, we sought to recruit at least 20 participants at the beginning of the study. To test hypothesis #2, all scores on the Senior Fitness Test, Physical Performance Test, and Physical Functional Performance-10 were converted to standard scores so that the various units and magnitudes of test scores could be compared. The standard scores from the six tests that make up the Senior Fitness Test were averaged to determine the 'overall' improvement in fitness. Likewise the five subscale scores from the Physical Functional Performance-10 test were averaged to determine the 'overall' improvement in Instrumental Activities of Daily Living. Paired T-tests were then used to compare the Physical Performance Test and the 'overall' Physical Functional Performance-10 score to the 'overall' Senior Fitness Test score. Finally, regression analysis was administered to determine the magnitude of change in the 'overall' Senior Fitness Test score relative to the Physical Performance Test and Physical Functional Performance-10 'overall' score.

Results

Twenty-one individuals were originally recruited to take part in this study. Three participants' physicians did not clear them to participate in the activity classes. In addition, four individuals decided they did not want to participate in the training program after completing the first round of testing. No one dropped out of the study once the control period began. Therefore, of the 20 people initially recruited, 4 men and 10 women completed the entire study. Mean age of this group at the onset of the study was 82 ± 4 yr, height averaged 162 ± 12 cm, and weight averaged 75 ± 15 kg. Several participants had typical but stable chronic diseases and conditions that accompany older age, such as hypertension, coronary artery disease, arthritis, cancer, diabetes, and back pain. One individual had Parkinson's Disease. They ingested from 5 to 12 medications on a daily basis. Participants attended an average of 17 of the 20 training sessions (85%), with one person attending only 15 sessions and two people attending all 20.

As shown in Table 1, there were no significant changes in test scores during the control period, with the exception of a 2.5% increase in lower body flexibility as measured by the chair sit and reach test, a component of the Senior Fitness Test ($p = 0.007$). Following the training period, improvements ranging from 10-40% ($p < 0.02$) were seen on all measures of Instrumental Activities of Daily Living (i.e. Physical Performance Test and Physical Functional Performance-10) as well as on the arm curl test, chair stand, and 6-min walk of the Senior Fitness Test.

Table 1. Test Score Results For All Three Time Points

TEST	TIME 1 (Pre-Control)	TIME 2 (Post-Control)	TIME 3 (Post-Exercise)
Physical Performance Test	21.1 ± 0.7	21.7 ± 0.7	23.2 ± .7*
Physical Functional Performance 10			
Total Score	34.6 ± 3.3	34.4 ± 3.8	45.1 ± 4.4*
Subscales			
Upper Body Strength	29.5 ± 3.2	30.3 ± 3.3	37.0 ± 3.7*
Lower Body Strength	26.1 ± 2.9	26.9 ± 3.2	37.8 ± 4.1*
Upper Body Flexibility	55.5 ± 5.3	51.1 ± 6.0	60.7 ± 6.34*
Balance & Coordination	37.1 ± 3.6	36.8 ± 4.3	48.5 ± 4.9*
Endurance	36.3 ± 3.5	35.8 ± 4.2	47.1 ± 4.7*
Senior Fitness Test			
Arm Curls (reps) (Upper body strength)	10.6 ± 0.7	11.1 ± 0.8	13.7 ± .8*
Chair stands (reps) (Lower body strength)	9.3 ± 1.2	9.1 ± 1.2	12.1 ± 1.3*
Back Scratch (in) (Upper body flexibility)	-6.4 ± 1.3	-5.5 ± 0.9	-6.0 ± 1.1
Sit and Reach (in) (Lower body flexibility)	-2.3 ± 0.7	-0.64 ± 0 .48^	-2.2 ± 0.7*
8 Foot Up & Go (sec) (Balance & Coordination)	10.6 ± 0.8	11.0 ± 1.3	9.6 ± 0.8
6 Minute Walk (meters) (Endurance)	299 ± 24	293 ± 25	326 ± 26 *

All values are presented as mean ± standard error of the mean. A '^' indicate a significance difference from pre-control to post-control ($p < 0.05$) and a '*' indicates a significant difference from post-control to post-exercise intervention ($p < 0.05$)

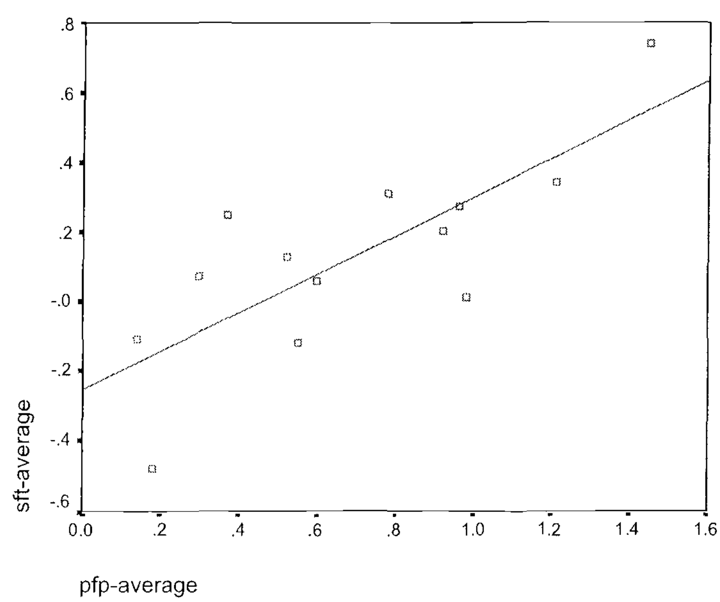
After changing all scores to standard scores, the results of the paired t-tests revealed that the magnitude of change in the Physical Performance Test (0.58 ± 0.15) and the 'overall' score for the Physical Functional Performance-10 (0.69 ± 0.11) was significantly greater ($p < 0.05$) then the magnitude of change in 'overall' score for the Senior Fitness Test (0.10 ± 0.08).

The regression analysis revealed a positive relationship between improvements in the 'overall' Physical Functional Performance-10 and the 'overall' Senior Fitness Test scores following the training program (Figure 1). This relationship was significant at $p = 0.002$ with an R^2 of 0.605. The regression equation to predict the 'overall' Senior Fitness Test standard score from the 'overall' Physical Functional Performance-10 standard score was:

*Senior Fitness Test = (Physical Functional Performance-10 * 0.560) - 0.258.*

The 0.56 slope of this equation indicates that for every unit of change in the Physical Functional Performance-10 'overall' score, there was only half as much of an increase in the Senior Fitness Test 'overall' score. There was not a significant relationship between the Physical Performance Test and the Senior Fitness Test ($p = .526$, $R^2 = .034$).

Figure 1. Relationship between change in Physical Functional Performance-10 and Senior Fitness Test



Discussion

The aim of this study was to determine the effect of a novel functional-based training program on older adults' ability to perform Instrumental Activities of Daily Living. Our first hypothesis was that there would be greater improvements on tests of Instrumental Activities of Daily Living (i.e. Physical Performance Test; Physical Functional Performance-10) following the training period compared to the control period. Our results supported this hypothesis, revealing a 10-40% improvement on all measures of Instrumental Activities of Daily Living after the training period compared to no significant changes on these same functional measures during the control period. Our second hypothesis was that following the training period, improvement in Instrumental Activities of Daily Living (i.e. Physical Performance Test; Physical Functional Performance-10) would exceed improvements in the underlying physical domains (i.e. Senior Fitness Test). Our results also supported this hypothesis, revealing that when converted to standard scores, there were significantly greater improvements in the Physical Functional Performance-10 and Physical Performance Test compared to improvements in the Senior Fitness Test. In fact, improvements in the Senior Fitness Test were only half the magnitude of the improvements observed in the Physical Functional Performance–10. There was not a significant relationship between the standard score of the Physical Performance Test and the Senior Fitness Test. However, this was not surprising since a majority of the Physical Performance Test is made up of fine motor functional skills while the Senior Fitness Test measures gross motor skills related to fitness.

The ability of an exercise program to improve the fitness and/or function of older adults is becoming increasingly recognized. The results of this study join many others that have shown that administering an exercise intervention to older adults can improve fitness in older adults compared to participating in their usual daily routine. The participants in our study took part in a 10 wk control period before taking part in the functional training program. With a similar design, Klein et al (2002) had participants take part in a 5 wk pre-training period before participating in a 10 wk flexibility training program. Klein et al. found no changes in flexibility during the control period but found significant improvements following the training program. Baum, Jarjoura, Polen, Faur, and Rutecki (2003) used a prospective, semi-crossover design to evaluate the effectiveness of a strength and flexibility program. In this study, participants in the control group participated in recreation activities three times a week for 6 months, then participated in a strength and flexibility program for another 6 months. Therefore, these participants acted as their own controls before taking part in the exercise intervention. This study similarly found no changes in strength and flexibility during the control period while finding significant changes following the exercise intervention.

Several studies that used a randomized design also reported significant improvements in strength (Cress et al., 1999; Fiatarone et al., 1994; Meuleman, Brechue, Kubilis, & Lowenthal, 2000; Worm, Vad, Puggaard, Stovring, & Kragstrup, 2001; Buchner et al., 1997; Jette et al., 1999), flexibility (Lazowski et al., 1999), endurance (Minor, Hewett, Webel, Anderson, & Kay, 1989), or measures of function (Nelson et al., 2004; de Vreede et al., 2004; Miszko et al., 2003; Cress et al., 1999) among subjects who participated in a training program compared to those in a control group. All of these studies support the notion that older adults can experience improvements in fitness and function following an appropriate training stimulus and that these changes do not occur during routine activities.

While many studies have shown that an exercise intervention can positively impact older adults' fitness, when the goal is to improve function, research indicates that a study's result seems to depend on the functional outcome variable used along with the type of exercise program administered. When a specific, unidimentional measure of function (e.g. gait velocity, step ups, or chair stands) is used as the outcome variable, the exercise stimulus can also be unidimentional as long as the physical domain that is used as the exercise stimulus is analogous to the desired outcome. For example, to improve the basic functional measures of step ups and gait velocity, Sherrington & Lord (1997) administered an exercise program to older adults that consisted of one month of step-ups onto a 5cm stepping block at least once a day. The exercise group significantly improved both walking velocity and performance on the step up test. Rooks, Kiel, Parsons, & Hayes (1997) randomized 131 older adults into a resistance training, walking, or control group to determine whether they would improve their stair climbing speed and a timed pen pickup. The resistance training group improved in stair climbing speed and the pen pick up test while the walking group improved in only stair climbing speed. Both of these studies' exercise programs targeted only one or two physical domains, but led to improvements in a related functional task. However, a key to their success was that the domain targeted was very comparable to the outcome variable tested. Klein et al. (2002) did not find improvements on a basic functional measure, the Timed Up & Go, with a program focusing on the domain of flexibility since the Timed Up & Go is a test of mainly balance and mobility not flexibility.

Research has revealed that when a more complex measure of function is used as the outcome variable it is harder to see improvements in function with a training program that only focuses on one or two physical domains. As the outcome variable becomes more similar to actual Instrumental Activities of Daily Living, a more comprehensive approach to training provides the best results. Following a 3 month training program that targeted flexibility, balance, body handling skills, speed of reaction, coordination, and strength, Brown et al., (2000) found improvements in a more complex functional test, the Physical Performance Test. Similarly, Lazowski et al. (1999) found improvements on the Functional Independence Measure following an exercise program targeting multiple domains such as flexibility, endurance, balance, and strength. However, Skelton et al., (1995) did not find improvements on the same functional test following an exercise intervention targeting only the physical domain of strength. Similarly, Buchner et al. (1997) was not able to show improvements on more complex functional measures (SF-36, Lawton Instrumental Activities of Daily Living scale, and gait speed and stair climbing speed) with a 24-26 wk strength training and/or endurance training program. An exception to this, however, is a few studies that have found beneficial impacts of a single domain exercise program on measures of function among a sample of individuals with arthritis (Ettinger et al., 1997, Kovar et al., 1992 & Minor et al., 1989). A possible explanation of this may be that adults who have disability caused by chronic arthritis respond particularly well to exercise interventions (Keysor & Jette, 2001).

We used one of the most comprehensive performance based functional tests currently available, the Physical Functional Performance-10, as the outcome variable in the current study. This is a shorter version of the 15 item Continuous Physical Functional Performance test (Cress et al., 1996). Cress et al. (1999) used the Continuous Physical Functional Performance test to evaluate changes among a group of older men and women following a combined endurance-resistance exercise training program. The exercise program took place 3 times a week for 60 min and consisted of upper and lower body strength training exercises and endurance training. The results indicated that the exercise group increased significantly over the control group in the total score of the Continuous Physical Functional Performance. Most of these observed improvements were due to differences in upper body strength, lower body strength, and endurance as significant differences were found for these specific sub-scores. There was no significant difference between the exercise group and control group in the sub-scores of balance, coordination, and upper body flexibility. This, however, is not surprising since these domains were not specifically targeted in the exercise intervention. Miszko et al., (2003) also used the Continuous Physical Functional Performance test to measure whether a power training or resistance training exercise program was more effective at improving functional performance in older adults. The results revealed that the Continuous Physical Functional Performance test total score was significantly greater for the power training group than for the strength training group. However, like the previous study, most of these observed improvements were due to differences in only some of the physical domain sub-scores.

In this current study the participants also significantly improved their Physical Functional Performance-10 total score following the activity intervention. However, unlike Cress et al. (1999) and Miszko et al. (2003), improvements were observed in all of the sub-scores of the Physical Functional Performance-10, indicating that our activity program was comprehensive enough to stimulate improvements in many physical domains.

These findings can all be attributed to the key underlying concept of Specificity of Training (Brooks et al., 2000). This refers to the idea of overloading movements that are as similar as possible to those movements that wish to be improved. The ability to perform daily activities such as doing the laundry and making the bed are not limited to a single physical domain but rather involve a combination of domains such as strength, balance, endurance, reaction time, and coordination. Therefore, because more comprehensive exercise studies touch on more of the physical domains needed to complete functional tasks, they show more promising results when a more complex functional outcome variable is used. We successfully did this by having exercises in our program that mimicked several functional tasks. Our program had participants practicing these functional tasks in a progressive circuit training program.

There is only one other known study that has also used a training program made up of exercises mimicking daily tasks (de Vreede et al., 2004). The training program was used to improve the functional ability of older women. For that study, functional performance was assessed using the Assessment of Daily Activity Performance which was also modeled after and very similar to the Continuous-Scale Physical Functional Performance Test. The results of that study were very similar to ours in that their 12 wk functional task training program was able to significantly improve the Assessment of Daily Activity Performance total score and all physical domain sub-scores.

Because of the Principle of Specificity, we hypothesized that there would be greater improvements in measures of function than fitness since our exercise program was specific to functional performance. Our results revealed that while we still were able to improve some areas of fitness, such as strength and endurance in the Senior Fitness Test, improvements in these areas were not as great as the improvements seen in function. Very similar to this, de Vreede et al. (2004) revealed that the individuals who took part in their functional-task training program improved significantly more on the total score and 3 of 5 subscores of the Assessment of Daily Activity Performance test than individuals who took part in a traditional resistance training program.

Of the other known studies that evaluated both fitness and function as outcome measures following an exercise program, all of them used a traditional fitness based program, challenging one or more of the physical domains as the training stimulus (Buchner et al., 1997, Skelton et al., 1995, Klein et al., 2002). In accordance with the Principle of Specificity, those studies all found greater improvements in fitness than function. For example, Buchner et al. (1997) administered a 24-26 wk strength training and/or endurance training program to try to improve functional measures. The participants in that study improved their strength and endurance, but showed no improvement in function. Similarly, Skelton et al. (1995) administered a progressive resistance training program to 75 to 90 yr old women. After 12 wk the women demonstrated improved strength and power of the knees, arms and legs, but had very limited improvements in function. Finally, Klein et al. (2002) administered a 10 wk proprioceptive neuromuscular facilitation exercise intervention to older adults (73-94 yr). Following the training program the participants had improved range of motion in the shoulder and ankle, but found no change in function. These opposing outcomes highlight the importance of designing a training program to meet the specific needs of the older adults to which it will be administered.

A strength of the LIFE functional training program is that it was able to significantly improve the ability to carry out Instrumental Activities of Daily Living among a group of older adults who had a wide range of initial abilities. Although all of our participants resided in a retirement community, their functional levels were very different, ranging from frail to independent and active. We were able to modify our program so that is was safe yet challenging for people with a wide range of functional abilities. We were able to achieve this because our program was individualized and progressive, initially adjusting the difficulty of each task in the circuit to match the abilities of the participant and gradually progressing from there. A limitation of the training program is that it was very equipment intensive, requiring items such as a clothes dryer and basket, grocery items and shelf, vacuum cleaner, suitcase, and steps. In addition to requiring a significant financial investment, most of this equipment was not portable, thus requiring a dedicated space for storage at each class location. However all the equipment used are items that are commonly found in an individual's household. Therefore, this program could very easily be done at a person's home. In fact, this type of program could be ideal for physical and occupational therapists working with individuals in a home setting.

A strength of our study design is that all of our participants acted as their own controls, significantly increasing our power. In addition, the same research assistants performed the tests on all three occasions, which were administered at the same location and at the same time of day each time. A limitation of this study design is that since the participants volunteered to take part in this study, they may not be representative of the general population. Therefore, the results of this study cannot be generalized to all individuals living in retirement communities. A second limitation is that we did not quantify the participants' activity level nor their subjective feelings of confidence or energy level during the control period and the training period. Thus, we do not know if they actually increased their participation or their confidence in carrying out Instrumental Activities of Daily Living during their daily routine. We were also not able to support the notion that participating in this functional-based activity program would lead to greater improvements in Instrumental Activities of Daily Living than participating in a comprehensive fitness-based exercise program, but hope to answer that question in a future study.

In conclusion, both of our hypotheses were successfully met. The LIFE functional-based training program was able to significantly improve older adults' ability to perform Instrumental Activities of Daily Living. In addition, this training program was able to improve some measures of fitness such as strength, endurance and lower extremity flexibility. However, these improvements were not as great as the improvements in function since the program was specifically designed to improve function. It is widely accepted that older adults can improve their abilities following an appropriate training stimulus. The key to creating a successful exercise program for older adults is to determine where their limitations are or what their goals are and to develop a training program that will specifically stimulate those areas. If one of their goals is to perform daily tasks more easily, then the exercise program must include some type of functional tasks. This will help keep older adults independent and out of nursing homes for as long as possible.

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CHAPTER THREE: CONCLUSION

With the number of older adults in the U.S. growing rapidly, more and more older individuals are at risk of losing their independence. This, in turn, will significantly increase the number of elderly nursing-home residents and functionally dependent individuals in the community. In addition to this, the cost of living in a nursing home is increasing rapidly, thus placing a major financial burden on individuals and their families. Therefore, on an economic as well as humanitarian basis, sustaining an older adult's ability to live independently is the focus of much research today.

Research shows that low physical activity levels and a sedentary lifestyle are a predictor of functional decline with aging (Spirduso & Cronin, 2001). Therefore, many have tried using exercise to improve the function of older adults. The results of these studies have only affirmed the importance of abiding to a key principle of training known as the Principle of Specificity (Brooks et al., 2000). Just as with any other training goal, with a goal of improved functional performance, the best results come when the program overloads movements that are as similar as possible to those movements that wish to be improved. Because living independently requires an individual to carry out daily functional tasks without assistance, given the Principal of Specificity (Brooks et al., 2000) an exercise program composed of these functional tasks would be the most specific and efficient way to improve the functional abilities of older adults. The LIFE Functional Training Program is set up as a circuit with 9 different stations, each mimicking a daily functional task. Each station lasts 2 min. The specific activity stations are: sit-to-stands, stair climbing, sweeping, vacuuming, carrying groceries, getting up-and-down-from the floor, putting on and taking off a jacket, pulling a suitcase, and carrying laundry. Each participant was given an initial goal for each station based on his or her own functional level. Once this goal was achieved on two consecutive training days, the intensity level for that station was increased.

Our program was able to significantly improve older adults' ability to carry out Instrumental Activities of Daily Living in addition to fitness parameters such as strength, endurance, and lower extremity flexibility. Since the program was not specifically designed to improve fitness, there was greater improvement on the functional measures than the fitness measures, supporting the Principle of Specificity.

Results of the de Vreede at al. (2004) study demonstrated that a functional - based training program is more effective at improving functional performance than a resistance training program. It would be interesting to now compare the LIFE functional training program to a multi-component exercise program. For example, a future study could have one group of older adults participate in the LIFE functional training program while a similar group of older adults participate in an exercise program composed of traditional strength, endurance, mobility and balance activities, comparing improvements in the ability to perform Instrumental Activities of Daily Living at the end of the training period. Furthermore, it would be a good idea to include some type of subjective self-efficacy scale in addition to the objective functional measures. I feel very confident that we would have seen improvement in such a measure in our study. A majority of comments from our participants expressed only feelings of improved confidence and self-efficacy when performing daily tasks.

This whole research experience has not only left me with a greater appreciation for the research process itself but has proved to me the importance of being as specific as possible when developing and prescribing exercise programs. In addition, it has left me with a great fondness towards the older adult population, now knowing that this is the population I want to work with in the future. Our novel functional training program is a great alternative to a traditional exercise program when the goal is to improve performance on Instrumental Activities of Daily Living. It not only can greatly improve functional performance in a wide range of functional levels, but it is also fun and different. Being such a novel program, we were unsure of how well the program would be tolerated by our participants. It was very encouraging to see that all participants accepted and enjoyed the program. Due to the success of our program, I would encourage physical therapists or other exercise professionals to consider this type of a program when working with individuals to improve function and independence.

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APPENDICES

Appendix A: Literature Review

The Older Adult

United States residents over the age of 85 are the fastest growing segment of the population (US census 2000). As of the year 2000, there were 4,240,000 million adults over the age of 85 in the United States and this is expected to double by the year 2025 and increase fivefold by the year 2050 (US census 2000). Aging is associated with declines in many physical domains including strength, balance, flexibility, reaction time, coordination, and muscular and cardiovascular endurance (Spirduso, 1995). There has been much evidence showing that substantial loss in these physical domains does not result from the aging process alone but rather results from the "interactive effects of aging, disease, and disuse" (Buchner & Wagner, 1992). Therefore, a significant proportion of the decline in the physical domains is preventable. In aging studies, when individuals with disease are identified and removed from the study, the remaining healthy people show less physical decline (Buchner & Wagner, 1992). Research also shows that low physical activity levels and a sedentary lifestyle can be a predictor of functional decline with aging (Spirduso & Cronin, 2001). For example, there are several studies showing that more rapid decline in aerobic capacity occurs among individuals with a sedentary lifestyle and physical activity can reduce much of this loss (Dill, Robinson, & Ross, 1967; Dehn & Bruce, 1972).

These declines in the physical domains are, in turn, a major determinant of loss of function in later life. For example, the physical domain of strength may explain as much as 25% of the variance in overall functional status (Buchner & DeLateur, 1991). This loss of function is specifically related to a decline in the ability to independently accomplish instrumental activities of daily living (IADL). IADL's reflect an individual's ability to maintain a safe and effective household, including preparing meals, shopping, taking medication, managing money, using the telephone, performing heavy chores and light housekeeping, transportation, and laundry (Spirduso, 1995). The inability to perform activities of daily living is what sociologist Saad Nagi refers to as a disability in his disablement model. Specifically, according to Nagi, a disability is a "limitation in performance of socially defined activities and roles expected of individuals within a social and physical environment" (Verbrugge and Jette, 1993). This coined term "disability" is the last in a hierarchy of outcomes in Nagi's diablement model. Through four central concepts, this model describes the pathway leading to disability. The first concept is pathology, which refers to "biochemical and physiological abnormalities that are detected and medically labeled as disease, injury or congenital/developmental conditions." Next in the hierarchy is impairment. Impairments are "dysfunctions and significant structural abnormalities in specific body systems." This refers to dysfunctions in the physical domains of muscle strength, range of motion or flexibility, maximum oxygen uptake, body composition, and neuromuscular control. The third outcome, which is a result of impairment, is functional limitation. This is restriction in basic physical and mental actions such as walking, reaching, stooping, climbing stairs and producing intelligible speech. Finally, these functional limitations can lead to the fourth concept of disability. The progression of Nagi's model indicates that disability originates from disease or disuse, with disease leading to impairment, impairment to functional limitation, and functional limitation to disability (Rikli & Jones, 1999; Verbrugge & Jette, 1993).

The inability to complete IADLs is of vital importance since the extent to which an individual can live independently depends on his or her ability to perform these basic tasks (Shephard, 1990). In fact, an IADL limitation is what can eventually force an individual to move into a long-term care facility. Based on 1984 data from the Longitudinal Study on Aging, individuals with a high level of functional ability were associated with a lower risk of mortality and less likely to have used a nursing home (Harris et al., 1989). In the United States today, there are nearly 2 million persons (mean age 84 years) living in long-term care facilities (Suzman, Willis, & Manton, 1992). In addition, for every resident of a long-term care facility, there are at least two elderly individuals with similar functional limitations who live in the community (Suzman, Willis, & Manton, 1992). It is estimated that by 2030, 14 million adults will not be able to conduct their daily activities independently (Zedlewski, Barnes, Burt, McBride, & Meyer, 1990), thus indicating the potential amount of older adults who are at risk of losing their independence. In fact, by the year 2040 there is expected to be a fivefold increase in the number of elderly nursing-home residents and functionally dependent individuals in the community (Suzman, Willis, & Manton, 1992).

Not only is the loss of independence a distressing aspect of aging for many older adults, but this loss also has substantial implications for national health care costs. The cost of living in a nursing home is approximately $40,000/year today and is expected to increase to $97,000/year by 2030 (Long Term Preferred Care). In addition, the cost of frailty in this country is approximately $54 billion a year

(Spirduso, 1995). Therefore, the focus of geriatric care has shifted to the prevention of disability and protecting independence.

Because research shows there to be such a strong relationship between regular physical activity and independent living, the most thoroughly studied way to prevent disability and loss of function in later years is through the adoption of a regular exercise program. Appropriate physical activity intervention is thought to prevent and even reverse much of the loss in IADL performance (Rikli & Jones, 1999). Due to the link between impairment, functional limitation, and disability, research has focused on administering exercise interventions to older adults aimed at improving an individual at the impairment level in hopes that it would subsequently improve function and prevent disability.

Researchers have used a variety of functional measures in order to assess the degree and rate of change in function. There are a variety of different functional tests existing today that are used among researchers to assess the impact of various exercise interventions on function. Methods of assessing function range from subjective self-report instruments to objective measures of performance on functional skills. Furthermore, these available functional measures used in research lie on a continuum ranging from testing very basic functional tasks to testing much more involved functional tasks.

Tests to Measure Function Among Older Adults

Tests to Measure Basic Functional Tasks

There are a group of functional tests that researchers have used to test very basic, general functional tasks. These tests include gait speed, chair stands, and stair climbing. Gait speed (Imms & Edholm, 1981) is a common used measure to monitor mobility and involves timing an individual while he or she walks over a known distance. The distances used to calculate gait speed have ranged from 8m to 15m (Lord et al, 1996; Judge, Underwood, & Gennosa, 1993; Minor, Hewett, Webel, Anderson, & Kay, 1989; Ades, Ballor, Ashikaga, Utton, & Nair, 1996). The timed chair rise (Jones, Rikli, & Beam, 1999) consists of timing an individual rising from a standard chair without the use of the arms for support on the chair. Stair climbing involves timing an individual ascend and then descend a set amount of stairs. Some have used a set of 14 steps (Rooks et al., 1997) while others have used only one step (Sherrington & Lord, 1997).

The Timed Up & Go Test (TUG) and The Senior Fitness Test

The Timed Up & Go Test (TUG) (Podsiadlo & Richardson, 1991) is a widely used performance-based measure of function. It is a little more comprehansive than gait speed, chair stands, and step ups. The TUG consists of timing an individual as he or she stands, walks 3 m, turns 180 degrees, and returns to the chair and sits down. The score on the test is the time it takes (in seconds) to complete the task. Some have administered modifications to the TUG (Bravo et al., 1996) by requiring the individual to perform two complete circuits of this task.

The Senior Fitness Test is used to assess the physical domains of strength, endurance, balance, and flexibility and some basic functional tasks, including the TUG (Rikli & Jones, 1999). The specific test items include: a 30 sec chair stand to assess lower body strength, the arm curl to assess upper body strength, the 6 min walk test for aerobic endurance, the chair sit-and-reach for lower body flexibility, the back scratch to assess upper body flexibility, and the 8-ft up-and-go to assess dynamic balance. The 30 sec chair stand is the number of full stands that can be completed in 30 sec with arms folded across chest. The arm curl test is the number of bicep curls that can be completed in 30 sec holding a hand weight (5 lb for women and 8 lb for men). The 6-min walk test is the amount of distance that can be covered in a 6-min period at a self-selected pace. Rest breaks are allowed as needed. The score is the total distance covered in 6 min. For the chair sit-and reach, the participant is in a sitting position at the front of a chair with the leg extended and hands reaching, one over the other, toward the toes. The number of inches (+ or -) between extended fingers and tip of toe is recorded. Finally, the back scratch is performed with on hand reaching over the shoulder and one up the middle of the back. The number of inches between the extended middle fingers (+ or -) is recorded. These are performed on the participants' dominant side only with the palm turned up as the weight is raised. The 8-ft up-and-go is the number of seconds required to get up from a seated position, walk 8 ft, turn, and return to a seated position. Each item is scored separately and can be compared to normative standards that were developed from a national study of 7,000 independent-living men and women ages 60-94 yr throughout the United States (Rikli & Jones, 1999). Rikli and Jones (1999) have shown that for community-dwelling adults aged 60 yr and older, this test has content validity established through literature review and expert opinion, concurrent validity correlation coefficients ranging from .73-.83 when comparing each test item with an established criterion measure, and high test-retest reliability with intraclass correlation coefficients ranging from .80-.98 for the test items.

Functional Questionnaries

Because the testing of much more involved functional tasks such as cleaning and doing laundry are difficult to administer, many researchers have resorted to using a self-reported evaluation of function.

Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36)

The SF-36 is a standardized measure of health status (Ware & Sherbourne, 1992). It is a self-report questionnaire with eight subscales of health: limitations in physical function, physical role, social function, emotional role, bodily pain, mental health, vitality, and general health perceptions. The physical function subscale contains questions regarding the ability to perform demanding activities (e.g. running) and less demanding activities (e.g. vacuum cleaning), climb several flights of stairs, climb one flight of stairs, crouch, walk more than 1 km, walk several meters, walk 100 m, take a bath, and dress. This questionnaire takes approximately 10 min to complete. Scores on each of the subscales range from 0 to 100, with a score of 0 representing worst health and a score of 100 representing best health. In a sample of older adults over the age of 65 yr, the SF-36 has been shown to have test-retest reliability with interclass correlation coefficients ranging from .65-.87 (Andersen, Bowley, & Rothenberg, 1996). Previous research has also found the SF-36 to be valid in differentiating between groups with expected health differences (Brazier et al., 1992).

The FAST Functional Performance Inventory

The FAST Functional Performance Inventory (Rejeski et al., 1995) is a self-report meaure that combines 23 questions from several previous studies on activities of daily living. This questionnaire contains five distinct activity subscales: basic ADLs (e.g. dressing onself), complex IADLs (e.g. doing light housework), ambulation and climbing (e.g. climbing stairs), transfer activities (e.g. getting in and out of a car), and upper extremity tasks (e.g. lifting heavy objects). Participants were asked to assess how much difficulty they have doing each activity in the questionnaire because of health or physical problems. Answers ranged from 1 (usually done with no difficulty) to 5 (unable to do). An overall score is created by averaging the scores on all 23 items.

The Lawton Instrumental Activities of Daily Living scale

The Lawton Instrumental Activities of Daily Living scale asks questions regarding the degree of ability in such areas as using the telephone, shopping, housekeeping, laundry, mode of transportation, ability to handle finances, and responsibility for medications (Lawton & Brody, 1969).

Older American Resources and Services (OARS): Instrumental activities of daily living (IADL) and Physical activities of daily living (PADL).

The OARS PADL includes questions regarding eating, grooming, walking, getting in and out of bed, bathing or showering, getting to bathroom on time, and continence. The OARS IADL includes questions regarding using the telephone, shopping for groceries or clothes, transporting self to places out of walking distance, preparing meals, doing housework, taking medicine, and handling money (Duke University Center for the Study of Aging and Human Development, 1978).

The Barthel Index

The Barthel Index is a functional measure which tests very low levels of function. This test consists of questions regarding one's ability in areas such as feeding, moving to bed, grooming, toileting, bathing, walking, climbing stairs, bladder control, and bowel control (Kane & Kane, 1981). There is also a performance-based version of this test (Mahoney & Barthel, 1965).

More Comprehensive Performance Measures

Some researchers have attempted to develop more comprehensive performance based measures to test much more involved functional tasks such as the tasks asked about in the self-report measures.

The Physical Performance Test (PPT)

The physical performance test (PPT) is used to measure individuals' functional performance on usual daily activities, including both BADL and IADL (Reuben & Siu, 1990). The basic activities of daily living (BADL) are the self-care skills that an individual performs daily to maintain health and hygiene. This includes dressing, bathing, toileting, grooming, getting in and out of bed or chairs, locomoting, and eating (DeVries, 1997). There is a 7-item and a 9-item PPT. The 9-item involves the following tasks: writing a sentence, simulated eating, donning and doffing a jacket, turning 360 degrees while standing, lifting a book onto a shelf, picking up a penny from the floor, walking 50ft, climbing a flight of stairs, and climbing several flights of stairs. Some have used a modified version of this by replacing simulated eating and writing a sentence with five chair rises and the progressive Romberg: eyes open condition. Scoring for these items is based on the time it takes to complete the item. Per a standardized protocol, time is converted to a 0-4 scale. Overall scores range from 0-36 with a higher score representing better performance. Previous research has deemed the PPT to be a reliable test (Cronbach's alpha = .87) and a valid measure of physical performance for community-dwelling older adults over the age of 65 yr with a concurrent validity coefficient of .80 when compared to accepted functional status assessments (Reuben & Siu, 1990).

The Functional Independence Measure (FIM)

The FIM (Keith, Granger, Hamilton, & Sherwin, 1987) requires specially trained persons to rate individuals on their level of assistance while performing 18 various tasks related to self-care (feeding, dressing, bathing), sphincter management, mobility/transfers (bed, chair, toilet, tub), and locomotion (walking, stairs). Degree of assistance is rated from 1=total assistance to 7=complete independence. FIM scores can range from 18-126 with higher scores indicative of higher functioning.

The Berg Balance Scale

The Berg Balance Scale (Berg, Wood-Dauphinee, Williams, & Gayton, 1989) is a very low level performance-based measure of function. It consists of 14 items that are scored on a 5-point scale (0=unable to perform, 4=independent) based on the ability to complete the task. The items are sitting to standing, standing unsupported, sitting unsupported, standing to sitting, standing with eyes closed, standing unsupported with feet together, reaching forward with outstretch arm, retrieving an object from the floor, turning to look behind, turning 360 degrees, placing alternate foot on stool, standing with one foot in front, and standing on one foot. The scores on the 14 items are combined for a total score, ranging from 0 to 56, with a higher score indicating a better performance.

Continuous-Scale Physical Functional Performance Test (CS-PFP)

The CS-PFP is the most comprehensive performance-based measure of function currently available. It includes 15 everyday tasks essential to independent living (Cress et al., 1996). Participants are instructed to complete as many tasks as possible. They are encouraged to perform each task safely but to work at their maximal perceived effort. The tasks are ordered from easiest (personal), to moderate (household), to most difficult (mobility). The Personal tasks include: carrying a pan of water a distance of 1 m, carrying and then pouring from a jug of water into a cup, donning and removing a jacket and a seat-belt, and placing and removing a sponge from the highest adjustment of a sliding shelf. The Household tasks include: sweeping a set amount of kitty litter into a dustpan from a prescribed area, transferring 7.7 kg of laundry and sandbags from the washer to a dryer and then to a basket which is then set on the counter, pulling of a spring scale to simulate the opening of a fire door, making a double bed with fitted sheet, comforter, and pillows, and vacuuming a set amount of oats from a prescribed area of carpet. The Mobility tasks include: carrying sandbags in a luggage carry-on bag from a park bench, up a 3-stair public transportation platform and returning to the bench, distributing groceries into one or two paper bags covered with plastic bags and carrying the groceries a distance of 70 m, including ascent and descent of the public transportation platform and negotiating a closed door, walking as far as possible in 6 min, getting into and out of a bathtub, and climbing a set of stairs. These 15 tasks are categorized into five physical domains (upper and lower body strength, flexibility, balance, coordination, and endurance). A subscale score is determined for each physical domain based on time taken to complete the task, weight carried, or distance traveled and the five subscales are averaged to determine the total score. A higher score represents better performance. Cress et al. (1996) have shown this test has test-retest reliability with interclass correlation coefficients ranging from .84 to .97 when tested on adults aged 70 yr and older. Additionally, they have shown this test to be valid in that it was capable of distinguishing physical functional performance among three groups (community dwelling older adults, long-term care facility residents, and residents with some dependence). In order to enhance its applicability, a shorter and more portable version of the Cs-PFP was developed. This shorter version includes only 10 items and is called the Physical Functional Performance 10 (PFP-10) (Cress, Petrella, Moore, & Schenkman, 2003). The study of de Vreede, Samson, Meeteren, Duursma, & Verhaar (2004) developed a functional performance measure called the Assessment of Daily Activity Performance (ADAP) that was also patterned after and very similar to the CS-PFP.

Some have also developed their own performance-based measure of function by including test items such as lifting a shopping bag onto a surface, a kneel rise, a floor rise, stair walking, a chair rise, functional reach, and a corridor walk (Skelton et al., 1995).

Along with researchers using a wide array of measures to test for changes in function, many different exercise interventions have also been used. Therefore, this makes it very difficult to compare studies assessing function.

Exercise Programs Targeted to Older Adults

Impairment Level Exercise Programs Aimed at Improving Impairments

Numerous studies have shown that exercise can have a positive effect on impairments in the physical domains. For example, focusing on the domain of cardiovascular fitness, Minor et al. (1989) demonstrated how a group of individuals with arthritis could improve their aerobic capacity and endurance after taking part in 12 wk of either aerobic walking or aerobic aquatics. Within the domain of flexibility, a group of assisted-living older adults (73-94 yr old) who participated in 10 wk of proprioceptive neuromuscular facilitation exercises for the hips, shoulders, ankles, and feet improved range of motion in the shoulder and ankle (Klein et al., 2002). Many authors have demonstrated individuals can improve in the physical domain of strength (Judge, Whipple, & Wolfson, 1994; Meuleman et al., 2000; Worm et al., 2001; Lazowski et al., 1999; Bravo et al., 1996; Sherrington, Stephen, & Lord, 1997; Lord et al., 1996; Ades et al., 1996; King et al., 2000; Judge, Underwood, & Gennosa, 1993; Rooks et al., 1997; Ettinger et al., 1997; Buchner et al., 1997; & Jette et al., 1999) Among these, Fiatarone et al. (1990) demonstrated observed gains in strength of approximately 174% in institutionalized older adults aged 90 yr who participated in an 8 wk strength training program at 80% of 1RM. Focusing on multiple physical domains, Snow and Shaw (1998) reported significant increases in balance, lower-body muscular strength, muscular power, and leg lean mass among post-menopausal woman who performed weight-bearing exercises for 9 months 3 days/wk. Similarly, individuals (mean age 80) improved balance performance to a level of an individual 3 to 10 yr younger and significantly increased isokinetic strength after taking part in a 3 month intensive balance and lower body strength training program (Wolfson et al., 1996). Others have also used exercise to improve impairments in two or more physical domains (Buchner et al., 1997; Ettinger et al., 1997; Rooks et al., 1997; Bravo et al., 1996; & Lazowski et al., 1999).

Impairment Level Exercise Programs Aimed At Improving Function

Research using basic functional tasks as the outcome measure

There are numerous studies that have shown that the basic functional task of gait velocity can be substantially improved after the administration of an impairment level exercise program (Lord et al, 1996; Judge, Underwood, & Gennosa, 1993; Minor, Hewett, Webel, Anderson, & Kay, 1989; Ades, Ballor, Ashikaga, Utton, & Nair, 1996). Sherrington & Lord (1997) used step-ups and gait velocity as functional measures for their study. Forty-two individuals, post hip fracture and ages 64-94, were randomly allocated to either a home-based weight bearing exercise program or a control group. The exercise program consisted of one month of step-ups onto a 5cm stepping block at least once a day. Participants initially began with 5 to 50 repetitions each time. The step-up test required participants to step up onto a 5.5cm and a 10.5cm block. The exercise group significantly improved on both walking velocity and the step up test (a significantly greater number of intervention subjects were able to successfully complete this test without hand support). Stair climbing speed was used as a measure of function in a study involving 131 older adults over the age of 65 (Rooks, Kiel, Parsons, & Hayes, 1997). In addition, a timed pen pickup task was used as a second measure of functional capacity. Participants were randomized into a resistance training, walking, or control group. Designed to strengthen hip and knee extension and ankle plantar flexion and dorsiflexion, the resistance training consisted of climbing a set of stairs while wearing a weighted nylon skin-diving belt around the waist. In addition, participants completed standing plantar flexion exercises and standing knee raises with the belt. The resistance training group improved in stair climbing speed and the pen pick up test while the walking group improved in stair climbing speed. Both Rooks et al. (1997) and Sherrington & Lord (1997) used a training task (step ups and stair climbing) that was very similar and specific to the functional outcome measure. Therefore, it is not surprising both found improvements in function. Alexander et al., (2001) similarly used the very task specific exercise of bed and chair rises in order to successfully improve older adults' ability to rise from a bed and chair. However, Judge, Whipple, and Wolfson (1994), who used gait velocity and chair rise time as functional measures, did not find such positive results. This study involved randomly assigning 110 subjects over the age of 75 yr to one of four groups (control, resistance training, balance training, or combined resistive/balance training group). Both the resistance training group and balance training group took part in 45 min long sessions held three times weekly for the 3-month intervention. The resistance training session involved knee extension and flexion, hip abduction and extension, and plantar and dorsiflexion using simple resistive machines and sandbags. The balance training group performed exercises on a computerized balance platform and the floor to improve postural control. Finally, the combined resistance/balance training group performed the full resistance and balance training at each session, lasting 95 min long. Beside improvements in strength among the resistance and combined group, there were no improvements in the functional measures of gait velocity or chair rise time.

Research using the Timed Up & Go Test (TUG) as the outcome measure

Bravo et al. (1996) used the TUG and gait velocity as outcome functional measures. In this study, 124 post-menopausal women between the ages of 50 and 70 yr were randomized into an exercise group or a control group. The exercise group took part in walking, stepping up and down from benches, aerobic dancing, and flexibility exercises for 60 min, three times a week over a period of 12 months. After the 12 months, the exercise group significantly improved on both functional measures. Cavani et al. (2002) found improvements on the TUG (as part of the senior fitness test) in a group of 22 older adults ages 60-79 yr who took part in 6 wk of stretching and moderate-intensity resistance training. However, Klein et al. (2002) found different results for residents (73-94 yr old) of an assisted-living facility who took part in a proprioceptive neuromuscular facilitation (PNF) exercise intervention. This intervention involved a 5-wk pretraining period consisting of weekly visits by trainers followed by a 10-wk training period of warm-up, PNF exercises, and cooldown. While this program improved range of motion in the shoulder and ankle it had no impact on the TUG test.

Research using functional questionnaires as the outcome measure

Worm et al. (2001) used the SF-36 and the Berg Balance Scale for 46 community-dwelling frail older adults over 74 yr of age. Participants in this study participated in a 60 min exercise program consisting of flexibility training, aerobics, rhythm, balance and reaction exercises, and muscle training (strength and endurance).

This intervention took place twice a week for 12 wk. After 12 wk, the exercise group had significantly greater increases on both functional measures compared to the control group. Ettinger et al. (1997) used the FAST Functional Performance Inventory (Rejeski et al., 1995). Along with this questionnaire, a combination of basic functional tasks was used for a more objective measure of functional ability. These basic tasks consisted of: a 6 min walk, stair climb and descent, lifting and carrying a 10-lb weight, and getting in and out of a simulated car. A total of 439 community-dwelling adults, aged 60 yr or older, with radiographically evident knee arthritis participated in this study. Participants were randomized into either an aerobic walking training program, a resistance exercise training program designed to strengthen all major muscle groups of both the upper and lower extremities, or a health education group. Both exercise interventions met 3 days per week over an 18-month period. Results indicated that both exercise groups improved over the control group on the basic functional measures and there were modest improvements on the physical disability questionnaire. Meuleman et al. (2000) used the OARS Physical Activities of Daily Living (PADL) and Instrumental Activities of Daily Living (IADL) scale to test for functional status on 58 frail elderly over the age of 60 yr. Participants were randomized into either a resistance/endurance exercise group or a control group receiving no intervention. The strength training exercises took place three days a week and consisted of exercises for the knees, shoulders, elbows, and ankles. The endurance training took place twice a week using an upper extremity ergometer, a stationary cycle, or a recumbent stepper. Exercise sessions continued until the patient was discharged from the nursing home or for a maximum of 8 wk. Results indicated that only those individuals who at enrollment were most dysfunctional significantly improved in functional activity. With a very similar population of older adults, McMurdo & Johnstone (1995) used the Barthel Index as a self-reporting measure of Activities of Daily Living. Along with this measure, the TUG and the chair stand test were used as basic measures of function. Eighty-six older adults (mean age 82 yr) with limited mobility and dependence in functional activities of daily living were randomized to a strength exercise group, a mobility exercise group, or a health education group. After 6 months, there were no significant differences between the groups with regard to changes in any of the outcome variables. Buchner et al. (1997) similarly did not find improvements in a self-reported measure of functional ability. For this study the Lawton Instrumental Activities of Daily Living (IADL) scale (Lawton & Brody, 1969) and the SF-36 health survey was used. Along with this, gait speed and stair climbing speed were used as functional measures. Older adults (n=181) between the ages of 68 and 85 yr old were randomized to either a strength training (ST) group, an endurance training (ET) group, a strength and endurance training (ST + ET) group, or a control group. The ET group did 30-35 min of endurance exercise each session using bicycles. The ST group did two sets of 10 repetitions of strength training exercises. Finally the ST + ET group did 20 min of endurance training and one set of strength training exercises. All exercise groups lasted for 24-26 wk, 3 days per week, for 1 hr. While there were improvements in strength and endurance, there were no effects of exercise on any functional measures. King et al., (2000) also used the SF-36 health survey to assess function and found similar results. One hundred three adults aged 65 yr and older were randomized to either a Fit & Firm group consisting of one hour of endurance and strengthening exercises or to a Stretch & Flex group consisting of one hour of stretching and relaxation exercises. For both conditions, participants were encouraged to participate in two exercise classes each week and to exercise on their own at home at least twice a week. While there were improvements in strength and endurance, there were no effects of exercise on any functional measures.

Research using comprehensive performance based tests as the outcome measure

Along with using the TUG test, gait speed, and stair climbing as functional measures, Lazowski et al. (1999) used the Functional Independence Measure (FIM). Sixty-eight residents from five Long Term Care institutions participated in this study. Participants were classified as low or high mobility and then randomized into either the Functional Fitness for Long-Term Care (FFLTC) Program or a seated range of motion (ROM) program. The FFLTC Program included progressive strength, balance, flexibility, and endurance training. Furthermore, the FFLTC Program was tailored to meet the needs of both high and low mobility residents. The ROM program consisted of seated range of motion exercises for the fingers, hands, arms, knees, and ankles. Both programs were conducted for 45 min, three times per week for 4 months. The FFLTC group improved on the TUG test however there were not significant changes in gait speed or stair climbing. Furthermore, FIM scores were maintained in the FFLTC, and significantly deteriorated in the ROM condition.

Brown et al. (2000) used the physical performance test (PPT). Brown's PPT is slightly modified from the original PPT in that the last two items (simulated eating and writing a sentence) are replaced with five chair rises and the progressive Romberg:

eyes open condition. This modified PPT was used on 84 physically frail older adults (mean age, 83). Participants were randomized into an exercise program (EXER) or a home exercise control group (HOME). The EXER group performed 22 exercises that were designed to enhance flexibility, balance, body handling skills, speed of reaction, coordination, and strength. The HOME group performed nine exercises that were designed to challenge range of motion only. Results indicated that the EXER group increased significantly over the HOME group on the PPT. Binder et al., (2002) and Nelson et al., (2004) also found improvements on the PPT after administering a comprehensive exercise program to a group of older adults. Nelson et al. (2204) included strength, balance, and physical activity in their exercise program while Binder et al., (2002) focused on the multiple areas of flexibility, strength, balance, and endurance. Using a similar array of tests, Skelton et al. (1995) did not find such positive results. The functional tests used in the Skelton et al. (1995) study included lifting a bag onto a surface, a kneel rise, a floor rise, stair walking, a chair rise, functional reach, and a corridor walk. For this study, 47 women aged 75 and older were randomized into a training or control group. Training was comprised of a one hour supervised session and two unsupervised home sessions made up of strengthening exercises for the shoulder abductors, hip abductors, adductors, flexors and extensors, elbow flexors and extensors, and knee flexors and extensors. Despite a small improvement in step up height, there was no improvement on any functional test.

Cress et al. (1999) used the CS-PFP on a group of men and women 70 yr or older. Fifty-six individuals were randomized to either a combined endurance-resistance exercise training program or a non-exercising control group. The exercise program took place 3 times/wk for 60 min and consisted of upper and lower body strength training exercises at 75-80% of an estimated 1RM and endurance training on kayak and single stair stepper equipment at 75-80% of heart-rate reserve. The results indicated that the exercise group increased significantly over the control group in CS-PFP total score. Most of these observed improvements were due to differences in upper body strength, lower body strength, and endurance as significant differences were found for these specific physical domain scores. There was no significant difference between the exercise group and control group in the physical domains of balance, coordination, and upper body flexibility. This, however, is not surprising since these domains were not specifically targeted in the exercise intervention, thus indicating the need of a more comprehensive program targeting all the physical domains. The CS-PFP was also used in study that wanted to determine whether a power training or strength training program was more effective for improving function in older adults (Miszko, Cress, Covey, Agrawal, & Doerr, 2003). Thirty-nine men and women (mean age =72.5) were randomly assigned to a control group, a strength training group, or a power training group. The strength training a power training groups met three times a week for 16 wk while control group only attended three lectures during the course of the study. Results revealed that the power training group improved significantly more than the strength training group on the CS-PFP total score. These observed improvements were due to difference in the physical domain sub scores of balance and coordination, endurance, and upper body flexibility. This is similar to the results of Cress et al (1999) in that improvements were only in some of the physical domain sub scores, thus reinforcing the need of a more comprehensive program targeting all the physical domains.

The study of de Vreede et al., (2004) used a functional measure that was modeled after and very similar to the Continuous-Scale Physical Functional Performance Test (CS-PFP) and was able to find improvements in all the physical domain sub scores. This study, however, did not use an impairment level exercise program when trying to improve functional performance. This study is the only other known study that used an exercise program made up of daily tasks. de Vreede et al (2004) wanted to determine whether a functional-task exercise program would have a different effect on the ability of older adults to perform daily tasks than a traditional resistance exercise program. For this study, 98 healthy women aged 70 and older were randomly assigned to the functional-task exercise program, a resistance exercise program, or a control group. Both exercise programs were performed three times a week for 1 hr for 12 wk and consisted of a 10 min warm up and cool down. The functional-task program was divided into a practice phase, a variation phase, and a daily tasks phase with each aimed at improving daily tasks. The resistance exercise program consisted of exercises aimed to strengthen the muscles groups that are important for daily tasks. Functional performance was assessed using the Assessment of Daily Activity Performance (ADAP) which was modeled after and very similar to the Continuous-Scale Physical Functional Performance Test (CS-PFP). Results revealed that after the 12 wk, the functional task training group scored significantly higher than the control group on the ADAP total score and all the sub scores.

Furthermore, the functional task training group had a significantly greater increase on the ADAP total score and 3 of 5 sub scores than the resistance training group.

This review of literature indicates that a study's outcome seems to depend on the functional measure used as the outcome variable as well as the type of exercise program administered. Most of the studies that found improvements in basic functional tasks, used a basic training program focusing on one or two domains. For example, Sherrington & Lord, (1997) only used step-ups in their intervention. Similarly, Rooks et al. (1997) only focused on one domain (strength or endurance) in each exercise group. However, Bravo et al. (1996) and Cavani et al. (2002) both found improvements on the TUG, while administering very different exercise programs. Bravo et al. used a very comprehensive program targeting multiple domains whereas Cavani et al. focused on only the two domains of strength and flexibility. Therefore, when a more basic measure of function is used, improvement in that measure does not seem to depend on the number of domains targeted in the exercise intervention. This is assuming, of course, that the domain or domains that are targeted are comparable to the functional outcome measure used. Klein et al. (2002) did not find improvements on the TUG with a program focusing on the domain of flexibility since the TUG is a test of mainly balance and mobility not flexibility.

Research has revealed that when a more comprehansive measure of function is used as the outcome variable, it is harder to see improvements in function with a training program that only focuses on one or two physical domains. As the functional measure becomes more similar to the actual activities of daily living, a more comprehensive approach to training seems to provide the best results. This is demonstrated among studies using a self-report method to test function. For example, using a very comprehensive exercise program targeting the domains flexibility, endurance, rhythm, balance, reaction time, and strength, Worm et al. (2001) showed improvements in the SF-36 health survey. After administering an exercise program only focused on the two domains of strength and endurance, Meuleman et al. (2000) found improvements in only the most dysfunctional participants. Buchner et al. (1997) and King et al. (2000) did not find any improvement among exercise groups taking part in programs targeting one or two domains. Similarly, McMurdo & Johnstone (1995) did not find any improvement with the use of a single domain targeted exercise intervention. An exception to this, however, was the study done by Ettinger et al. (1997) who focused on only the one domain of strength training or aerobic training and found improvements on a physical disability questionnaire. These improvements however were small. Furthermore, the population used was unique in that all participants contained radiographically evident knee osteoarthritis and pain. Others have also found beneficial impacts of a single domain exercise program on self-reported measures of function among a sample of individuals with arthritis (Kovar et al., 1992 & Minor et al., 1989). A possible explanation of this may be that adults who have disability caused by chronic arthritis respond particularly well to exercise interventions (Keysor & Jette, 2001).

This same trend can be seen among studies using more comprehensive performance based measures of function. Using a very comprehensive exercise program targeting flexibility, balance, body handling skills, speed of reaction, coordination, and strength, Brown et al., (2000) found improvements in a more specific functional test, the PPT. Nelson et al., (2004) and Binder et al., (2002) also found improvements on the PPT with a comprehensive program targeting many physical domains. Similarly, Lazowski et al. (1999) found improvements on the FIM using an exercise program targeting multiple domains such as flexibility, endurance, balance, and strength. However, Skelton et al. (1995) did not find improvements on the same functional test using an exercise intervention targeting only the physical domain of strength.

Using the most specific, comprehensive performance based functional test, Cress et al. (1999) found selective improvements in function with an exercise intervention only targeting two domains. However, these improvements were only in those functional tasks that involved the two domains focused on in the intervention. Miszko et al. (2003) similarly only found improvement in some of the physical domain sub scores of the CS-PFP test with an exercise program targeting only one physical domain. On the other hand, using a very similar test as these two studies, de Vreede et al. (2004) was able to significantly improve all the physical domain sub scores using a program made up of exercises mimicking daily tasks.

A possible explanation for these findings can be attributed to a key underlying concept of specificity of training (Brooks, Fahey, White, & Baldwin, 2000). This refers to the idea of overloading movements that are as similar as possible to those movements that wish to be improved. The ability to perform daily activities such as doing the laundry and making the bed are not limited to a single physical domain but rather involve a combination of domains such as strength, balance, endurance, reaction time, and coordination. Therefore, because more comprehensive exercise studies touch on more of the physical domains needed to complete functional tasks, they show more promising results when a more specific functional outcome measure is used. "Although one aspect of frailty may predominate (e.g., strength), other domains are likely also affected, suggesting that a comprehensive exercise approach should be the most effective for modifying frailty" (Brown et al., 2000).

Appendix B: Institutional Review Board Approval

INSTITUTIONAL REVIEW BOARD

OREGON STATE UNIVERSITY
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E-MAIL: IRB@oregonstate.edu · PHONE: (541) 737-3437 · FAX: (541) 737-3093

REPORT OF REVIEW

TO: Karen White,
Exercise and Sport Science

RE: Effects of a Functional-Based Training Program on Performance of Instrumental Activities of Daily Living in Frail Older Adults (Student Researcher: Jessica Carmona)

Protocol No. 2338

The referenced project was reviewed under the guidelines of Oregon State University's Institutional Review Board (IRB). The IRB has **approved** the application. This approval will expire on **11/10/2004**. This new request was reviewed at the Expedited level. A copy of this information will be provided to the full IRB committee.

Enclosed with this letter please find the original informed consent document for this project, which has received the IRB stamp. This information has been stamped to ensure that only current, approved informed consent forms are used to enroll participants in this study. All participants must receive the IRB-stamped informed consent document. Please make copies of this original as needed.

- Any proposed change to the approved protocol, informed consent form(s), or testing instrument(s) must be submitted using the MODIFICATION REQUEST FORM. Allow sufficient time for review and approval by the committee before any changes are implemented. Immediate action may be taken where necessary to eliminate apparent hazards to subjects, but this modification to the approved project must be reported immediately to the IRB.
- In the event that a human participant in this study experiences an outcome that is not expected and routine and that results in bodily injury and/or psychological, emotional, or physical harm or stress, it must be reported to the IRB Human Protections Administrator within three days of the occurrence using the ADVERSE EVENT FORM.
- If a complaint from a participant is received, you will be contacted for further information.
- Please go to the IRB web site at: http://osu.orst.edu/research/RegulatoryCompliance/HumanSubjects.html to access the MODIFICATION REQUEST FORM and the ADVERSE EVENT FORM as needed.

Before the expiration date noted above, a Status Report will be sent to either close or renew this project. It is imperative that the Status Report is completed and submitted by the due date indicated or the project must be suspended to be compliant with federal policies.

If you have any questions, please contact the IRB Human Protections Administrator at IRB@oregonstate.edu or by phone at (541) 737-3437.

Redacted for privacy

Dr. Anthony Wilcox
Institutional Review Board Chair

Date: 11/11/03

pc: 2338 file

Appendix C: Informed Consent Document

Oregon State University

INFORMED CONSENT DOCUMENT

Project Title: Will Extra Practice with Household Activities Help Older Adults Improve Their Ability to Perform Daily Tasks?
Principal Investigator: Karen White, PhD, PT

PURPOSE

This is a research study. The purpose of this research study is to determine the effect of a functional-based training program on the ability to perform Instrumental Activities of Daily Living (IADL) of older adults residing in retirement-communities who have difficulty performing one or more of the IADL's. IADL's are the tasks one must carry out to maintain a safe and clean household and include shopping, preparing meals, managing money, and doing laundry and housekeeping. The purpose of this consent form is to give you the information you will need to help you decide whether to be in the study or not. Please read the form carefully. You may ask any questions about the research, what you will be asked to do, the possible risks and benefits, your rights as a volunteer, and anything else about the research or this form that is not clear. When all of your questions have been answered, you can decide if you want to be in this study or not. This process is called "informed consent". You will be given a copy of this form for your records.

We are inviting you to participate in this research study because you are over the age of 70 and living in a retirement-community. You are able to walk with or without the use of a cane but need assistance with one or more of the instrumental activities of daily living. A total of 40 men and women are expected to participate in this study.

PROCEDURES

If you agree to participate, your involvement will last for approximately 24 hours spread over a 24- week period. The following procedures are involved in this study.

If you decide to participate you will begin by taking part in two days of testing. Testing will take approximately 2-3 hours. On the first day you will undergo the Physical Performance Test to determine if you are eligible to participate in this study. If you are not eligible, you will not engage in any further testing. If eligible you will undergo the Senior Fitness Test and will be given the SF-36 health survey and a health history questionnaire to complete at home and a medical clearance to mail to your doctor. On the second day of testing, you will undergo the Physical Functional Performance 10 (PFP-10). Below is a brief description of the tests.

Physical Performance Test (PPT)

This test measures your ability to perform usual daily activities and includes writing a sentence, simulating eating, donning and doffing a jacket, turning 360 degrees while standing, lifting a book, picking up a penny from the floor, walking 50 ft, and climbing a flight of stairs. You will be asked to complete each task as quickly as you can. This test takes about 10 minutes to finish.

Senior Fitness Test

This test will measure your strength, endurance, balance, and flexibility. You will be asked to perform a 30 second chair stand to assess your lower body strength, arm curls for 30 seconds to assess upper body strength, a 6-minute walk to assess your endurance, a chair sit-and-reach to assess your lower body flexibility, the back scratch to assess your upper body flexibility, and the 8-Foot Up-and-Go to assess your balance. You will be asked to give your best effort on all the tests. This test takes about 20 minutes to complete.

Physical Functional Performance 10 (PFP-10)

This test measures your ability to perform 10 everyday tasks essential to independent living. The tasks include: carrying a pan of water, putting on and removing a jacket, picking up four scarves from the floor, placing and removing a sponge from a shelf, sweeping up kitty litter, transferring laundry from a washer to a dryer and then from the dryer to a basket, carrying groceries, walking as far as possible in 6 minutes, sitting and standing up from the floor, and climbing a set of stairs. These tasks will be ordered from easiest to hardest and you will be asked to complete as many tasks as possible. Each task should be performed at your maximal perceived effort and you may rest whenever needed. This test takes approximately 30 minutes to complete.

After testing, you will take part in a 10-week control period consisting of weekly social visits from the research staff. You will be asked not to change your daily routine during the 10-weeks. After these social visits, you will be tested again on all of the same tests as before the control period. Then you will take part in a 30-minute functional based training program twice a week for 10 weeks at the place in which you reside. This is a brand new, original training program that is geared at improving an individual's ability to perform daily tasks. The training program is a multi-station circuit with 9 different exercise stations that mimic daily functional tasks. The stations include: sit-to-stands, stair climbing, transferring laundry, carrying groceries, vacuuming, sweeping, dressing, pulling luggage, and getting up and down from the floor. You will spend two minutes at each station and will be allowed to take as many breaks as you need. At the beginning and end of this 30 minute program, you will participate in a 5-10 minute warm up and cool down consisting of gentle movements and stretching.

RISKS

As with any form of exercise, there is risk of muscle strain, fatigue, and soreness with participating in this research project. The increased activity also increases your risk of falling or experiencing a fall-related injury. In order to minimize these risks, the exercise program will be tailored to your abilities. You will progress through the training program at your own pace and will be allowed as many rest breaks as needed. The principle investigator is a physical therapist. She will train all staff on proper form and spotting for all the tests and the training program. You will wear a safety belt during testing to reduce the possibility for a fall. There will always be two staff members present during each training session and at least three staff members present during each testing session, including a researcher who is certified in CPR and First Aid. During both the testing and training, EMS will be available and called in case of an emergency.

BENEFITS

The potential personal benefits that may occur as a result of participation in this study include an opportunity to socialize with friends and research staff members. Participants will also learn of their current level of endurance, strength, flexibility, balance, and ability to perform daily functional tasks by participating in the testing.

CONFIDENTIALITY

Records of participation in this research project will be kept confidential to the extent permitted by law. However, federal government regulatory agencies and the Oregon State University Institutional Review Board (a committee that reviews and approves research studies involving human subjects) may inspect and copy records pertaining to this research. It is possible that these records could contain information that personally identifies you. When data is entered into the database, your name will be transferred into a code. In the event of any report or publication from this study, your identity will not be disclosed. Results will be reported in a summarized manner in such a way that you cannot be identified.

RESEARCH RELATED INJURY

In the event of research related injury, compensation and medical treatment is not provided by Oregon State University.

VOLUNTARY PARTICIPATION

Taking part in this research study is voluntary. You may choose not to take part at all. If you agree to participate in this study, you may stop participating at any time. If you decide not to take part, or if you stop participating at any time, your decision will not result in any penalty or loss of benefits to which you may otherwise be entitled. Any data collected from you prior to withdrawal will be destroyed.

QUESTIONS

Questions are encouraged. If you have any questions about this research project, please contact: Jessica Carmona at (541) 929-2984, email: jcarmona16@hotmail.com or Karen White at (541) 737-8198, email: Karen.White@oregonstate.edu. If you have questions about your rights as a participant, please contact the Oregon State University Institutional Review Board (IRB) Human Protections Administrator, at (541) 737-3437 or by e-mail at IRB@oregonstate.edu.

Your signature indicates that this research study has been explained to you, that your questions have been answered, and that you agree to take part in this study. You will receive a copy of this form.

Participant's Name (printed): ______________________________

____________________________________ ________________

(Signature of Participant) (Date)

RESEARCHER STATEMENT

I have discussed the above points with the participant or, where appropriate, with the participant's legally authorized representative, using a translator when necessary. It is my opinion that the participant understands the risks, benefits, and procedures involved with participation in this research study.

____________________________________ ________________

(Signature of Researcher) (Date)

Appendix D: Physical Performance Test Point System

Physical Performance Test Scoring Sheet

	Physical Performance Test		
	Time	Scoring	Score
1. Write a sentence (whales live in the blue ocean)	_____sec*	≤10 sec = 4 10.5–15 sec = 3 15.5–20 sec = 2 >20 sec = 1 unable = 0	_____
2. Simulated eating	_____sec	≤10 sec = 4 10.5–15 sec = 3 15.5–20 sec = 2 >20 sec = 1 unable = 0	_____
3. Lift a book and put it on a shelf	_____sec	≤2 sec = 4 2.5–4 sec = 3 4.5–6 sec = 2 >6 sec = 1 unable = 0	_____
4. Put on and remove a jacket	_____sec	≤10 sec = 4 10.5–15 sec = 3 15.5–20 sec = 2 >20 sec = 1 unable = 0	_____
5. Pick up penny from floor	_____sec	≤2 sec = 4 2.5–4 sec = 3 4.5–6 sec = 2 >6 sec = 1 unable = 0	_____
6. Turn 360 degrees	discontinuous steps continuous steps unsteady (grabs, staggers) steady	0 2 0 2	_____
7. 50-foot walk test	_____sec	≤15 sec = 4 15.5–20 sec = 3 20.5–25 sec = 2 >25 sec = 1 unable = 0	_____
8. Climb one flight of stairs†	_____sec	≤5 sec = 4 5.5–10 sec = 3 10.5–15 sec = 2 >15 sec = 1 unable = 0	_____
9. Climb stairs†	Number of flights of stairs up and down (maximum 4)		_____
TOTAL SCORE (maximum 36 for 9-item, 28 for 7-item)			_____9-item _____7-item

*For timed measurements, round to nearest 0.5 seconds.
†Omit for seven-item scoring.

Appendix E: Physical Functional Performance-10 Item Data Sheet

Cs-PFP 10 ITEM DATA SHEET

Testing Site:__________________ Study:__________________ Test #:__________ Tester:__________________ Date:__________________

Subject ID:_____________ Sex: M F Living Status: House Apt. Group Home Retirement Community SNF Other:_____________

Age:_____________ Height:_ (+50)__________________ cm Weight:__________________ kg

Primary Diagnosis: CVD Arthritis COPD Orthopedic Diabetes N/A

TASK	TIME	WEIGHT	CONVERSION	HEIGHT	LAPS (1=to/back from cone) Distance_______	PARTIAL LAP	TOTAL M	COMMENTS (log anything unusual about each task or overall)
Weight Carry	sec	kg	lbs/ 2.2 =					
time: sec., weight: kg	(3.5 - 9)	(2.273-29.545)						
Jacket	sec							Sm Med Lg XL 2X 3X
seconds	(10 - 60)							
Scarves	sec							
seconds	(2.5 - 10)							
Reach				cm	plus (51cm in lab) or ____ = ______			RIGHT LEFT
reach (cm) / height (cm)				(1.15 - 1.4 ratio)				
Floor Sweep	sec							
seconds	(15 - 75)							
Laundry 1	sec	**9 #/ 4.1 kg**						
seconds	(18 - 60)							
Laundry 2	sec	**9 #/ 4.1 kg**						
seconds	(12- 50)							
Floor Sit	sec							
seconds	(5 - 50)							
Groceries	sec	kg	lbs/2.2 =					
time: sec., weight: kg	(35 - 145)	(2.273-27.273)						
Walk					meters	m	m	
meters							(152.4 - 701)	
Stair Climb	sec				#stairs			
seconds	(4.18 - 14.3)							
TOTAL PFP TIME								
Overall PFP RPE								

Data entry:_____________________

(initial and Date)

Special Considerations: (if yes, ask if it is chronic or if today is different, log)

End of test: log anything unusual about any specific task or overall

Cs-PFP10dataupdate

Appendix F: Senior Fitness Test Normal Range of Scores

<b>8-Foot Up-and-Go

Purpose: To assess agility/dynamic balance, important in tasks that require quick maneuvering such as getting off a bus in time, or getting up to attend to something in the kitchen , to go to the bathroom, or to answer the phone.

Description: Number of seconds required to get up from a seated position, walk 8 feet (2.44 m), turn, and return to seated position.

Normal Range of Scores

Age Group	60-64	65-69	70-74	75-79	80-84	85-89	90-94
Chair stand (no. of stands)							
Women	12 - 17	11 - 16	10 - 15	10 - 15	9 - 14	8 - 13	4 - 11
Men	14 - 19	12 - 18	12 - 17	11 - 17	10 - 15	8 - 14	7 - 12
Arm curl (no. of reps)							
Women	13 - 19	12 - 18	12 - 17	11 - 17	10 - 16	10 - 15	8 - 13
Men	16 - 22	15 - 21	14 - 21	13 - 19	13 - 19	11 -17	10 - 14
6-min step (no. of yards walked)							
Women	545 - 660	500 - 635	480 - 615	430 - 585	385 - 540	340 - 510	275 - 440
Men	610 - 735	560 - 700	545 - 680	470 - 640	445 - 605	380 - 570	305 - 500
2-min step (no. of steps)							
Women	75 - 107	73 - 107	68 - 101	68 - 100	60 - 90	55 - 85	44 - 72
Men	87 - 115	86 - 116	80 - 110	73 - 109	71 - 103	59 - 91	52 - 86
Chair sit/reach (inches)							
Women	-0.5 - +5.0	-0.5 - +4.5	-1.0 - +4.0	-1.5 - +3.5	-2.0 - +3.0	-2.5 - +2.5	-4.5 - +1.0
Men	-2.5 - +4.0	-3.0 - +3.0	-3.0 - +3.0	-4.0 - +2.0	-5.5 - +1.5	-5.5 - +0.5	-6.5 - -0.5
Back scratch (inches)							
Women	-3.0 - +1.5	-3.5 - +1.5	-4.0 - +1.0	-5.0 - +0.5	-5.5 - +0.0	-7 - -1.0	-8.0 - -1.0
Men	-6.5 - +0.0	-7.5 - -1.0	-8.0 - -1.0	-9.0 - -2.0	-9.5 - -2.0	-9.5 - -3.0	-10.5 - -4.0
8-ft up-and-go (seconds)							
Women	6.0 - 4.4	6.4 - 4.8	7.1 - 4.9	7.4 - 5.2	8.7 - 5.7	9.6 - 6.2	11.5 - 7.3
Men	5.6 - 3.8	5.7 - 4.3	6.0 - 4.2	7.2 - 4.6	7.6 - 5.2	8.9 - 5.3	10.0 - 6.2

The Senior Fitness Test information is adapted from R. E. Rikli & C. J. Jones (1999). The Development and Validation of a Functional Fitness Test for Community-Residing Older Adults, Journal of Aging and Physical Activity, Champaign, IL: Human Kinetics.

For additional information, or to be placed on a mailing list for supportive materials (test manual, video, and fitness software), you can contact me at rrikli@fullerton.

Appendix G: John C. Erkkila, M.D. Endowment for Health & Human Performance Grant

Samaritan
Good Samaritan
Hospital Foundation

Building healthier communities together

3600 NW Samaritan Drive ◆ P.O. Box 1068 ◆ Corvallis, Oregon 97339 ◆ (541) 768-5479
www.samhealth.org

November 17, 2003

Karen N. White, PhD
Exercise and Sport Science
Oregon State University
104 Women's Building
Corvallis, OR 97331-6802

Dear Dr. White:

I am pleased to inform you that your project was among those chosen for funding by the John C. Erkkila, M.D. Endowment for Health and Human Performance. The amount of your grant is $11,500.00. Of the 16 proposals received, the committee selected 6 projects totaling just over $63,000.

The amount of your grant may be less than you initially submitted. In order to fund as many worthy projects as possible, the selection committee reviewed each budget carefully and looked for possible reductions in salaries, supplies, travel reimbursement and other areas. Those suggested modifications are part of the selection committee's meeting minutes and are available to you at your request.

By signing the enclosed letter of acceptance, you are agreeing to accept the grant amount offered. You are also agreeing to submit written progress reports to the selection committee at six- and 12-month intervals. A committee member may also contact you by phone or in person at some point during your project to ask about your progress. Please complete and return the enclosed acceptance letter and return it to us in the envelope provided no later than Friday, December 12.

Once we have received your signed acceptance letter, a check for the entire amount of the grant will be mailed to your attention shortly after the first of the year.

On behalf of the entire committee, please accept my sincere congratulations for receiving this grant. Your project certainly reflects the intent of the endowment, and we will look forward to learning of your progress.

Sincerely,

Redacted for privacy

John C. Erkkila, M.D.
Chair, Erkkila Endowment Committee

Security enhanced document. See back for details.

GOOD SAMARITAN HOSPITAL FOUNDATION
PO BOX 1068
CORVALLIS, OR 97330

2392

DATE Dec 23, 2003

96-401/1232
21

PAY TO THE ORDER OF Oregon State University $ 11,500.00

Eleven Thousand Five Hundred dollars + no/100 DOLLARS

Security features are included. Details on back.

MAIN OFFICE
CITIZENS BANK
P.O. BOX 30/CORVALLIS, ORE. 97339
XPRESS BANKING 766-2255
OUTSIDE THE LOCAL CALLING AREA 1-800-577-1778

Redacted for privacy

FOR Karen White-Erkkila Grant

Redacted for privacy

MP

JOHN C. ERKKILA, M.D. ENDOWMENT FOR HEALTH AND HUMAN PERFORMANCE

APPLICATION

1. **Title**: A Functional Based Training Program for Frail Older Adults

2. **Principal Applicant:** Karen N. White, Ph.D., PT
Co-Investigator: Jessica Carmona, B.A.
Title: Assistant Professor
Department: Exercise and Sport Science
Organization: Oregon State University
104 Women's Building
Corvallis, OR 97331-6802
Phone: 541-737-8198
Fax: 541-737-1341

3. **Total Amount Requested**: $15,128

4. **A concise description of the project objectives and the need the project addresses:**

The purpose of this study is to test hypotheses that focus on enhancement of human function and performance in older adults with outcomes applicable to a broad cross section of the community. Specifically, this study will determine the degree to which a progressive functional based training program improves the ability of frail older adults residing in retirement communities in Corvallis to perform activities of daily living. A unique contribution of this study is that the exercise stimulus consists of common functional tasks integral to maintaining a household, often called the Instrumental Activities of Daily Living (IADL).

The number of older adults in Oregon and the U.S. is growing rapidly, with those over the age of 85 years being the fastest growing segment of the population. In the United States there are nearly 2 million persons (mean age 84 years) living in long-term care facilities; generally because they are no longer able to care for themselves[7]. By the year 2040 there is expected to be a fivefold increase in the number of nursing-home residents[14]. The cost of living in a nursing home is approximately $40,000/yr today and is expected to increase to $97,000/year by 2030[10]. The total cost for nursing home care in the U.S. last year was $87 billion with only $44.9 billion of that being paid for by insurance. This, in turn, leaves about half the burden of nursing home costs falling on individuals and their families[10]. Given these projections in population and nursing home costs, there will be approximately $1.16 trillion/yr spent on nursing home care in 2040. Over the next 40 years, if there was a way to help these older adults maintain their independence and delay admission into a nursing home by even one year, there would be a savings of $624 billion. Therefore, on an economic as well as humanitarian basis, sustaining an older adult's ability to live independently is a very important goal of geriatrics and gerontology.

Research shows that there is a strong relationship between regular physical activity and independent living, with low physical activity levels and a sedentary lifestyle being a predictor of functional decline with aging[13]. Because living independently requires an individual to carry out daily functional tasks without assistance, given the Principal of Specificity[2], an exercise program composed of these functional tasks would be the most specific and efficient way to improve the functional abilities of older adults. This, in turn, will likely increase their years of independent living. Prior studies have not used a training program composed exclusively of functional tasks to achieve this desired outcome. Consequently, this study will make a unique contribution of new knowledge as it is designed to determine the degree to which a functional-based training program improves the ability of frail older adults to perform IADL's. Improving an individual's function and maintaining independence in later life can lead to improved self-confidence and perceived well-being. In addition, prolonging an older adult's ability to live independently will significantly reduce the burden of health care costs among the elderly, their families, and society.

5. **Describe additional financial support (if any) for the project detailed in this application:** All of Dr. White's efforts toward this project will be funded by Oregon State University. Additional financial support has not been requested for this project beyond the support of Holiday Retirement Corporation to recruit subjects and to use the facilities and any applicable equipment that may be available in the two Holiday Retirement communities in the Corvallis area (e.g., Stoney Brook & The Regent). See attached letter of support.

6. **Describe plans for support of this project once the grant funds are spent:** This project will determine how well the functional training program works and how it is received and tolerated by the target population. Based on the outcomes, we plan to apply for NIA funding to test a variety of hypotheses comparing this functional-based program with more traditional resistance and endurance exercise programs, including how well the different programs improve a frail adult's ability to carry out activities of daily living.

7. **Detailed description of the research project, including methodology:** See attached proposal.

8. **Resume of principal applicant:** Karen N. White, Ph.D., P.T. - See attached vita.

9. **Budget:**

Salaries/benefits	
Karen N. White, PhD, PT, principal investigator	no funding requested
Jessica Carmona, graduate assistant	
$11.25/hr x 10 hr/wk x 23 weeks (Jan – June)	$2,587.50
OPE @ $3.12/month x 6 months (Jan – June)	$18.72
$11.25/hr x 40hr/wk x 10 weeks (June – Aug)	$4,500.00
OPE @ $8% x 10 weeks (June – Aug)	$360.00
Undergraduate assistant	
$9.00/hr x 10hr/wk x 23 weeks (Jan – June)	$2,070.00
OPE @ $3.12/month x 6 months (Jan – June)	$18.72
Technician to build functional testing equipment 30 hrs @ $40/hr	$1,200.00
Services/supplies	
Stationary supplies, photocopying & postage	$200.00
Materials to build simulated bathtub, bus platform and shelving unit	$400.00
Testing supplies (weights, sandbags, totes, refreshments, etc.)	$1,200.00
Transportation of equipment to testing/intervention sites	$600.00
Subtotal	$13,154.94
Overhead (15% max)	$1,973.24
TOTAL REQUESTED	**$15,128.18**

Budget justification:
Salaries: Jessica Carmona, graduate assistant, will direct the functional training program and assist the P.I. with training and overseeing the student interns who will assist with the pre- and post-testing. She will also assist the P.I. with subject recruitment, set-up and storage of the testing and training equipment at the two sites, and management of the day-to-day aspects of the training protocol. During the summer she will be entering data into the computer, analyzing the results, and writing a manuscript. Due to university restrictions on the amount of time that a graduate student may work, Jessica is limited to working 10 hr/wk on this project during the school year. She will work full-time on this project over the summer. The undergraduate assistant will help with the physical activity classes and the pre- and post-testing, which will also average approximately 10 hr/week. Additional undergraduate interns will assist with just the testing and will not be paid. A person with basic carpentry skills will be hired to build some of the needed testing equipment (see below).

Supplies: Much of the functional testing will use actual equipment that is available at the retirement facilities, such as a washer and dryer, vacuum, and bed with linens. However, neither retirement community has bathtubs in their units, so a piece of equipment will need to be built so that the participants can simulate entering and exiting a bathtub. Other testing equipment that needs to be built includes the three-step bus platform and the adjustable shelving unit. Miscellaneous testing and training supplies such as weights, sand bags, jackets, luggage, tote bags and groceries need to be purchased. The estimated costs are based upon the costs published by the developers of the CS-PFP test, as posted on their website (www.coe.uga.edu/cs-pfp/before_testing/pfpadmin.html). Cookies, juice, and occasional treats will be necessary to assist with subject compliance. Some of the testing equipment is large and will require rental of a truck or van to transport the equipment to and from the university and between the two testing sites. Current cost for renting a university van is $38/day plus mileage and we anticipate needing to move the equipment 6 times.

Principal Applicant   Date

A FUNCTIONAL BASED TRAINING PROGRAM FOR FRAIL OLDER ADULTS

Background and Significance

The Instrumental Activities of Daily Living (IADL) are the tasks an individual does to maintain a safe and effective household[9]. The extent to which an individual can live independently depends on his or her ability to perform these functional tasks. Thus, IADL limitations can eventually lead an individual to lose independence and move into a long-term care facility. It is estimated that by the year 2040, 13.1 million persons in the United States will have at least one IADL limitation[14].

Impairments in the physical domains of muscle strength, flexibility, endurance, and neuromuscular control are often responsible for the inability to carry out functional tasks such as IADL[15]. Therefore, research has typically focused on administering interventions to older adults to mitigate or delay impairments in the physical domains in hopes that the older adults would subsequently improve functional ability and maintain independence. There is ample scientific evidence on the positive effects traditional exercise training programs have on improving strength, flexibility, and endurance. It is less clear as to the carry over effect these same types of training programs have on improving function. For example, Buchner et al.[3] found that strength training and/or endurance training did not improve measures of function in adults 68-85 years despite improvements in strength and endurance. The ability to perform IADLs is not limited to a single physical domain but rather involves a combination of domains. Therefore programs that include many physical domains tend to show more promising results. For example, Cavani et al.[5] showed that a training program involving many physical domains (e.g., strength, balance, flexibility, coordination and reaction speed) did improve measures of function among frail older adults. We opine that it is possible to improve functional performance to an even greater extent through a more targeted training program. Given the Principle of Specificity[2], an exercise program composed of common functional tasks that mimic IADL should lead to the greatest improvement in this area since participants train by doing the specific tasks they desire to improve.

Purpose and Specific Hypotheses

This study will determine the degree to which a progressive functional-based training program improves the ability of frail older adults residing in retirement communities in Corvallis to perform IADL.

Hypothesis #1 ~ Compared to the control group, the training group will have greater improvements on tests of IADL (e.g., Physical Performance Test; Continuous-Scale Physical Functional Performance Test).

Hypothesis # 2 ~ Within the training group, improvement in IADL (e.g., Physical Performance Test; Continuous-Scale Physical Functional Performance Test) will exceed improvement in the underlying physical domains (e.g., Senior Fitness Test).

Experimental Plan

Subjects ~ Fifty men and women volunteers will initially be recruited from two retirement communities in Corvallis (e.g., The Regent and Stoney Brook) through flyers and educational talks. Inclusion criteria include: 1) frail (according to participant's score on the Physical Performance Test); 2) over the age of 70 years; and 3) ambulatory with or without the use of a cane. If an individual is not able to follow directions or complete the baseline testing due to physical or cognitive impairments, he or she will be excluded.

Study Design ~ All testing and training will be conducted at the retirement community where the participants reside. During initial testing participants will be given an informed consent form to sign and will undergo the Physical Performance Test to determine whether they meet the "frail" inclusion criterion. Approximately 40 individuals are expected to meet this criterion and will continue with the other physical tests. They will also be given the Medical Outcome Study Health Survey to complete and a medical clearance form to mail to their physician. All testing procedures will be both explained and demonstrated to the participants. Testing will take a total of 2-3 hours and will be administered over the course of two days to allow for rest. Given that this is a frail, elderly population we expect that some individuals will be interested in participating in the training program while others will be willing to undergo testing but will have no desire to exercise on a regular basis. Therefore, we will not randomly assign participants into the training and control groups, but will allow them to choose based on their own preferences. We will match subjects in each group based on age, gender, and initial abilities. The control group will receive weekly social visits over the 10-week period while those in the training group will attend the activity sessions. After the 10-week study period all participants will undergo post-testing.

Testing Procedures ~ The following tests will be administered before and after the 10-week intervention:

Physical Performance Test. This test will be used to measure the subjects' functional performance on usual daily activities and will be used to monitor changes in IADL performance[11]. The nine specific tasks include: writing a sentence, simulating eating, donning & doffing a jacket, turning around 360 degrees, lifting a book onto a shelf, picking up a penny from the floor, walking 50ft, climbing a flight of stairs, and climbing several flights of stairs. Scoring for these items is based on the time it takes to complete the task. Per a standardized protocol, time is converted to a 0-4 scale. Overall scores range from 0-36 with a higher score representing better performance. To meet the frailty criteria, participants must score less than 32 but greater than 17 points overall[3].

Continuous-Scale Physical Functional Performance Test. This test is an in-depth measure of function using 15 everyday tasks essential to independent living and will be used to monitor changes in IADL performance[6]. The tasks include: carrying a pan of water, transferring laundry, boarding a bus, pouring water from a jug, carrying groceries, removing a jacket and seat-belt, sweeping, making a bed, vacuuming, pulling open a fire-door, reaching onto a high shelf, walking for 6 min, getting in and out of a bathtub, and climbing stairs. Scores are based on time taken to complete the task, weight carried, or distance traveled. These values are entered into a computerized algorithm that combines the raw data into an overall score[6]. A higher score represents better performance.

Senior Fitness Test. This test assesses the physical domains of strength, endurance, balance, and flexibility[12]. The specific test items include: a 30 sec chair stand to assess lower body strength, the arm curl to assess upper body strength, the 6 min walk test for aerobic endurance, the chair sit-and-reach for lower body flexibility, the back scratch to assess upper body flexibility, and the 8-Foot Up-and-Go to assess dynamic balance. Each test item is scored independently.

Medical Outcomes Study 36-Item Health Survey. This is a general measure of health status[1]. It is a self-report questionnaire with eight subscales of health: limitations in physical function, physical role, social function, emotional role, bodily pain, mental health, vitality, and general health perceptions.

Training Program ~ After baseline testing, the training group will participate in a 10-week functional-based training program. This is an original training program that consists of a multi-station circuit with eight different activity stations mimicking functional tasks. The sessions will be held twice a week and will begin and end with a 5-10 min warm up and cool-down. Each exercise class will contain ten participants. Two staff members will be present during every training session to provide proper supervision and motivation. Each individual will spend two minutes at each station. The goal at each station is to complete the task at least one time. When this goal is achieved on two consecutive training days, the participant will progress to the next intensity level for that station. Subjects will follow a predetermined progression based upon their own tolerance. The specific exercise stations include:

Station 1: Sit-to-Stand. Participants will begin with repeated sets of five sit-to-stand movements, taking as much time as needed between sets to rest. They will progress to sets of six, sets of eight, sets of ten, etc., until they can do the activity continuously for two minutes.

Station 2: Stair Climbing. Participants will complete one cycle of ascending three steps onto a platform and then descending and resting. They will progress to completing two cycles and then three cycles etc. before resting. The goal is to ascend and descend the stairs continuously for two minutes.

Station 3: Laundry. Subjects will carry a laundry basket containing five beanbags from a counter to the top of a dryer, transfer the beanbags into the dryer and then back into the basket, and then carry the basket back to the original counter. Once the participant is able to complete this task in two minutes the number of beanbags to be transferred will increase.

Station 4: Grocery Shopping. Subjects will transfer ten grocery items from shelves into a grocery cart, push the cart 20 ft out and back, and then distribute the groceries back onto the shelves. As the participant progresses the number of grocery items to be transferred will increase.

Station 5: Vacuuming. Participants will alternate between 30 sec of vacuuming and 30 sec of rest. The time of vacuuming will increase and rest periods will decrease by ten sec intervals until the participant is able to vacuum continuously for two minutes.

Station 6: Sweeping. Subjects will sweep a half-cup of kitty litter into a dustpan from a 4ft x 3ft-taped area, rest as needed, and then repeat the process. The participant will progressively increase the number of cycles of completing this task without resting.

Station 7: Dressing. Participants will put on and take off a series of three jackets that are progressively more complex. Once the participant is able to don and doff all three jackets within two minutes, the participant will use the hardest, most complex jacket only.

Station 8: Traveling. The participant will alternate between pulling a standard rolling suitcase filled with 30 lb of weight down a hall for 30 sec and resting for 30 sec. The pulling time will progressively increase and the resting time will progressively decrease by 10 sec intervals until the participant is pulling for the entire two min. Once the subject can pull the suitcase for the full two minutes, additional weight will be added to the suitcase in 10 lb increments.

Data Analysis ~ To detect a statistically significant difference between means at a power level of 0.80 and an alpha level of 0.05, at least 17 subjects per group are required[8]. To safely account for an expected 10% drop out rate, a total of 50 subjects will be recruited, with 40 meeting the inclusion criteria and approximately 20 electing to be in each group. To test hypothesis #1, a repeated measures ANOVA will be used to compare changes in IADL test results between groups and over time. To test hypothesis #2, delta scores will be calculated for each individual in the training group to determine amount of improvement on each test from pre- to post-testing. These scores will then be standardized into z-scores so that the various units and magnitudes of test scores can be compared. An ANOVA will be used to compare the amount of improvement in IADL compared to the underlying physical domains.

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