University of Tennessee, Knoxville

TRACE: Tennessee Research and Creative Exchange

Masters Theses

Graduate School

12-2005

Effect of long term resistance training on a senior population with trained peer leadership

Richard John Burke III
University of Tennessee, Knoxville

Follow this and additional works at: https://trace.tennessee.edu/utk_gradthes

Part of the Exercise Science Commons

Recommended Citation

Burke, Richard John III, "Effect of long term resistance training on a senior population with trained peer leadership. " Master's Thesis, University of Tennessee, 2005.
https://trace.tennessee.edu/utk_gradthes/4569

This Thesis is brought to you for free and open access by the Graduate School at TRACE: Tennessee Research and Creative Exchange. It has been accepted for inclusion in Masters Theses by an authorized administrator of TRACE: Tennessee Research and Creative Exchange. For more information, please contact trace@utk.edu.

To the Graduate Council:

I am submitting herewith a thesis written by Richard John Burke III entitled "Effect of long term resistance training on a senior population with trained peer leadership." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Exercise Science.

David R. Bassett, Jr., Major Professor

We have read this thesis and recommend its acceptance:

Dixie L. Thompson, Diane A. Klein

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

To the Graduate Council:

I am submitting herewith a thesis written by Richard John Burke III entitled "Effect of long term resistance training on a senior population with trained peer leadership." I have examined the final paper copy of the thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Exercise Science.

David R. Bassett, Jr.

David R Bassett, Major Professor

We have read this thesis and recommend its acceptance:

Dixie L Thyson

Diane A. Klein

Accepted for the Council:

Vice Chancellor and Dean of Graduate Studies

Thesis
2005
.S873

Effect of long term resistance training on a senior population with trained peer leadership

A Thesis Presented
For the Master of Science Degree
The University of Tennessee, Knoxville

Richard John Burke III
December 2005

Dedication

This thesis is dedicated to my wife Rena and my daughter Amanda who have never wavered in their support for this endeavor and to Faye and Allen Jeffries, my mother- and father-in-law, who picked up the slack when I was otherwise occupied. I would also like to dedicate this to my sister, Carolyn Burke and my aunt, Patricia Karsell who have always supported and believed in me. Finally, to Dr. Angela Lanier of Kennesaw State University, my friend, my professor and the one who started me down this road.

Acknowledgements

The author would like to express his thanks and appreciation for those who helped with this project.

My advisor, Dr. David Bassett. Thank you for serving as my advisor and a member of my thesis committee. Your guidance and support are greatly appreciated and were so important to the completion of this project.

Dr. Dixie L. Thompson and Dr. Diane Klein for serving as members of my thesis committee and always being there when I needed you. I was never afraid to ask questions and always received your guidance concerning any aspect of my education. Thank you for believing and caring, I will always be grateful.

Dr. Edward Howley who pushed me harder and further than I thought I could go. Thank you so much for everything that you taught me and for understanding that life happens and is often unpredictable.

Carolyn Albright, my friend and classmate who was always there to listen and help.

A special thanks goes to my parents Elizabeth and Richard who are no longer here, but I know are watching from afar. Thank you for instilling in me the values of life.

Finally, to the Cedartown community center and all the people who were part of this project. You gave me far more than I will ever be able to repay. Your willingness to put up with me for four years, your wonderful sense of humor through it all and your perseverance are things I will take with me always.

ABSTRACT

Purpose: The goal of this study was to examine the physical effects of a two-year peer-led resistance training and aerobic program in a group of community dwelling older adults.

Methods: Nine community-dwelling older adults (Age = 81.2 ± 7.1 yrs; Males = 1, Females = 8) were trained for six weeks, monitored and corrected for one year, and then completed two years of peer-led weight training three days/week. Pre and post training physical function assessments included 6-minute walk distance (endurance, functional mobility and gait speed), 8 foot timed up-and-go (balance and agility), back scratch (shoulder flexibility), sit-and-reach (flexibility), number of chair stands in 30 seconds (lower-body muscular endurance), number of arm curls in 30 seconds (upper-body muscular endurance). Data were analyzed by repeated measures ANOVA.
Results*:* There were no significant differences found between post-test 1 and post-test 3 in any of the measures. Any small decreases in the results can be accounted for by the increasing age of the individuals involved over the testing period. The preliminary results are as follows

1. 6-minute walk (-13 meters in 6-min)
2. 30 sec Arm Curls (+3.5 curls in 30 sec)
3. 8' up-and-go (-0.6 seconds over 8 feet)
4. Chair stands in 30 sec (-0.55 stands in 30 sec)
5. Sit and Reach (-0.17 inches)
6. Back Scratch (-1.17 inches)

Conclusions: The results of this project suggest that a peer-led physical conditioning program is an effective approach for maintaining the physical functioning of community-dwelling older adults.

Table of contents

Chapter Page

I. INTRODUCTION.....1

Purpose.....3

Hypotheses.....3

Expected Results.....4

II. REVIEW OF LITERATURE 5

Definition of Peer Leadership.....6

Definition of Sarcopenia.....8

Epidemiology.....10

Validation of Testing Methods.....12

6-Minute Walk.....12

30-Second Chair Stand.....13

Sit-and-Reach.....14

Timed Up-and-Go.....15

Dumbbell-Curl, Back-Scratch, and Establishment of Normative Scores.....17

Role of Exercise in Aging.....18

Physiological Adaptations to Strength Training in Older Individuals.....18

Maintenance of Muscle Strength.....20

Reliability of 1RM Testing.....22

Aerobic + Strength Training.....23

Aerobic Exercise Training.....24

Role of Muscle Size Response to Strength Training.....25

Role of Metabolic Rate in Strength Training...26

Role of Recovery in Strength Training.....27

Strength Training Effects on Muscle Characteristics.....28

Psychology and Aging.....30

Depression.....30

Health and Function.....32

Theory of Planned Behavior.....32

Quality of Life.....34

Balance and the Risk of Falls.....35

Role of Training for Activities of Daily Living.....36

Chair Rise Biomechanics.....36

Sit-to-Stand Performance.....37

Walking Performance and Cardiovascular Response.....39

Intervention Strategies.....40

Adherence.....43

Summary.....44

III. MANUSCRIPT.....46

Abstract.....46

Introduction.....47

Methods.....49

Participants.....49

Time Line.....50

Testing Protocol.....50

Statistical Method.....53

Results.....54

Physical Characteristics.....54

Discussion.....57

REFERENCES.....63

APPENDICES.....72

Appendix A: Informed Consent.....73

Appendix B: Health History Questionnaire....77

Appendix C: Tables.....81

VITA.....86

LIST OF TABLES

(Appendix C)

TABLE **PAGE**

1. Changes in tests of physical function resulting from a strength training program in community dwelling older adults.....56

2. 6-minute walk in meters walked.....82

3. Number of arm-curls in 30 seconds.....82

4. Number of chair-stands in 30 seconds.....83

5. 8 foot up-and-go.....83

6. Sit-and-reach to toes in inches.....84

7. Back scratch in inches between fingers.....84

8. Repeated measures ANOVA.....85

9. Tukey Post Hoc Test - Arm curls.....85

CHAPTER I

INTRODUCTION

Aging is a fact of life, and we are on the cusp of the largest increase in the elderly population in U.S. history. With the baby boom generation approaching retirement, it is imperative that we try to understand the physiological aspects of aging, and find a way to improve the physical conditioning of our aging population.

It is well known that sarcopenia, identified as the loss of muscle mass with increasing age, will reduce the physical abilities of older adults. Furthermore, it has also been sufficiently documented that aerobic exercise increases oxidative enzymes while resistance exercise increases overall myosin heavy chain synthesis, both of which mitigate the effects of aging on the muscle[3,4,8,9].

Furthermore, gait and balance worsen as a direct consequence of muscle strength loss, which becomes problematic in the elderly who are not engaging in regular exercise. Slips and falls are a major threat to

the elderly, partly due to problems with balance, but are also caused by skeletomuscular weakness. The resulting medical costs reflect the fact that those occurrences often lead to chronic debilitating conditions. Even though there is extensive research showing the positive effects of strength and aerobic training to reduce slips and falls[1,5,10,12], the necessary exercise programs have not yet been widely implemented in senior centers.

The limitation to most exercise programs has been lack of available leadership to train older individuals. A possible approach would be to recruit peer leaders among the participants, train them, and ultimately give them the leadership responsibility. This would allow the participating universities and or research facilities to use seniors and or graduate students during their practicum semesters to properly train peer leaders, and allow those universities the ability to reach more community centers. This approach would also allow the senior centers to be proactive,

offer more programs to improve health and physical well being.

Purpose

The purpose of this study was to examine the effects of peer exercise leadership in a group of community dwelling seniors on physical endurance, lower body strength, hamstring flexibility, fall risk, agility, and upper body strength.

Hypothesis

1. There would be little or no difference between the year 1 post-test and the final post-test in year 3 for the following tests:

    a. 6-minute walk[55]

    b. 8' up-and-go[59]

    c. Number of bicep curls in 30 seconds[57]

    d. Number of chair stands in 30 seconds[30]

    e. Sit and reach distance in inches[31]

    f. Shoulder Flexibility (back scratch) in inches[57]

Expected Results

It was expected that a 12 month resistance training program would increase muscle strength and physical functioning in a group of community-dwelling older adults, and that extending the program by instituting peer-led resistance exercise, would prevent any loss of physical functioning over the next two years.

CHAPTER II

REVIEW OF LITERATURE

The purpose of this research was to examine the effect of a peer-led, seated group dumbbell strength-training program on the physical function of older adults. Many of the recently reviewed studies were accomplished with machines, in laboratories or training centers, and not on site in community centers with dumbbells and chair exercises. Moreover, the exercise groups were led by researchers, and not peer leaders.

It is well established that muscle mass decreases with age, and that some decline will occur regardless of fitness levels or training amounts[3, 17, 18]. However, it has been shown in numerous studies that strength training is important for attenuating the age-related decline in muscle mass[13,18,22].

Studies have further indicated that increased muscle mass results both in increased muscle strength, and an improved ability to carry out activities of daily living in the elderly[15].

In advancing age, leg strength becomes critical. As leg strength is increased, however, the result should be a decrease in associated gait abnormalities that are commonplace in aging adults. Resistance training has been shown to improve standing balance, thereby reducing falls, and fractures[5,11,12].

Studies have shown that quality of life for older adults is closely related to their physical fitness[54] and that quality of life is directly associated with one's ability to participate in the activities of daily living[69]. One aspect of quality of life is depression, and studies suggest that aerobic exercise significantly lowers depressive symptoms[50] as well as exercising in the sunlight[40]. A recent review of the literature also suggests a well-recognized link between exercise and emotional well-being[7].

Definition of Peer Leadership

A peer leader is a person within the study group who is trained along with the others, but is singled out to lead the group exercise in the absence of the

instructor. Due to the lack of research on peer-led exercise groups, there is a need to understand the effect of peer leadership on the elderly population that frequent the community centers. During a search of the literature, it was found that there were no papers in peer-reviewed journals on peer led, community based, strength training programs. But this idea is critical if we are to reach the general population with interventions that have implications for obesity, diabetes, gait and balance, activities of daily living and even psychological issues.

The Center for Disease Control and Prevention (CDC), in the National Health and Nutrition Examination Survey III study for adults(table 69), shows that obesity in males ages 65-74 for the years 1960 to 2002 increased from 10.4% to 31.9%, and for females from 23.2% to 39.3%[47]. This puts those individuals at significant risk for type II diabetes[19]. Furthermore, recent studies show that exercise is useful in the prevention and treatment of type 2 diabetes[2].

Definition of Sarcopenia

Sarcopenia is generally understood as "the loss of muscle mass and the decline in muscle quality observed with increasing age"[60], and has been associated with morbid occurrences and health problems in older adults, including falls, glucose intolerance, decreased bone density, and osteoporosis[32].

In an editorial entitled "Sarcopenia Revisited" for the Journal of Gerontology, Morley[45] stated that resistance exercise remains the best way to increase muscle mass and strength and prevent further muscle loss.

Volpi et al.[73] in a review article funded by the National Institute on Aging found that sarcopenia is a multifaceted process encompassing endocrine function reduction, cellular level mitochondrial DNA alteration, decreased physical activity levels, and nutrition, all contributing to muscle mass reduction in normal aging. However the review states that exercise and nutrition can have a dramatic effect on strength and mass. In the case of nutrition this means an adequate intake of

calories and protein. By engaging in resistance exercise, muscle mass can be increased and insulin resistance can be improved along with protein synthesis in muscle.

LaStayo et al.[37] investigated chronic eccentric training to ascertain its feasibility in reversing sarcopenia and related impairments and functional limitations. The subjects consisted of 21 frail elderly with a mean age of 80 years who completed 11 weeks of lower extremity resistance training. 11 subjects used eccentric training, and 10 subjects used traditional training. Only the eccentric group experienced significant improvements in strength (60%), balance (7%), and stair descent (21%). They report that the timed up-and-go test improved in both groups but only the eccentric group went from high to low fall risk. They concluded that because of the low energy cost and high force production, eccentric exercise may be useful in patients who cannot progress with traditional methods.

Roubenoff[63] stated that while sarcopenia is not reversible, it can be attenuated by strength training. He recommends strength training programs for all adults over 60 years of age even while admitting they are difficult to administer.

Epidemiology

Brill et al.[9] in a 5-year muscular strength and physical function study examined 3069 men and 589 women ages 30 to 82 years of age. They found that those adults in the high strength group had a lower prevalence of functional limitations. Only 7% of men and 12% of women reported any type of limitation during the follow-up period. The results suggest that attempting to maintain strength throughout one's life may reduce the incidence of functional abnormalities.

Metter et al.[44] studied 1071 men in the Baltimore Longitudinal Study of Aging over a 25 year period, and found that loss of strength in men over 60 years of age was more important than the strength level in predicting all-cause mortality. Indeed, they found that

initial muscle strength was a significant predictor of all-cause mortality for those over 60 years of age. They also found that functional performance was directly dependent on maintaining strength in the face of age-related sarcopenia.

Klein et al.[35] investigated muscle strength, size and bone density in 43 men ages 23, 77, & 86 years of age. As expected, they found the muscle cross sectional area, strength, and bone density was lower in older individuals. However, it has been shown in many studies that strength training will have a positive effect on bone density.

Frontera et al.[23] in a 12-year longitudinal study on aging skeletal muscle in 12 healthy sedentary men (initial mean age 65.4 ± 4.2), stated that loss of muscle cross sectional area is a major factor in the loss of muscle strength that occurs with normal aging. They found a significant decrease in type I fibers with an increase in type II fibers which they state was unexpected because the literature (cross sectional studies) does not back it up. Nonetheless, they did

find a decrease in capillary density with advancing age, but no difference in the mean fiber area. In conclusion, they strongly encouraged older adults to engage in resistance exercise to prevent sarcopenia.

Validation and Testing methods

6-Minute Walk

Rikli and Jones[55] assessed the reliability and validity of the 6-minute walk as a test measure in older adults. They recruited 77 participants, 48 females and 29 males (mean age 73.1 ± 7.2 years). Walks were conducted outdoors over a flat 50 yard rectangle marked off every five yards. Temperature during the three tests was between 68°F and 75°F. Subjects were tested 3-6 at a time with a 10s staggered start, and were verbally encouraged as they walked. At the 6-minute mark, they stopped in place and waited for a distance measurement to be taken. Each test was performed 3-5 days apart. Each participant was give a graded exercise test using a modified Balke protocol[2], and functional ability was established using a

composite physical function scale developed for the test. It was used to assess activities of daily living including exercise. It was correlated by comparing with previously published scales. Physical activity was compiled through self report. For the walking protocol, test-retest reliability and construct validity were checked against known measures. Their conclusion is that the 6-minute walk has good test-retest reliability especially when a pre-test is administered and can be used to assess the physical endurance of older adults.

30-Second Chair Stand

Jones et al.[30] assessed the 30-s chair-stand as a measure of lower body strength in community-residing older adults. A 30-s time limit was imposed instead of a fixed number of chair stands because some of the older population would never meet such a criteria. They recruited 76 older adults, (34 men and 42 women mean age 70.5 ± 5.5 years) for the test. Each individual's leg press 1RM was established in two sessions of two to five days apart. The subjects were then tested on the

chair stand on two different days, two and five days apart. Half of them were on a two day interval, and the other half on a five day interval. Also recruited were 190 male and female residents from a retirement housing complex (mean age 76.2 ± 6.7) to determine the test's ability to detect differences in performance between those who were 60, 70, and 80 years of age. Those results indicated that chair stands performed declined in a linear fashion as age increased. Their results suggest that the moderate correlation between chair stand and weight adjusted leg press performance support the criterion-related validity of the chair stand. It has good test-retest reliability and gives a reasonably valid indication of lower body strength in generally active community dwelling older adults.

Sit-and-Reach

Jones et al.[31] assessed the reliability and validity of a chair sit-and-reach test as a measure of hamstring flexibility in older adults. 76 participants were recruited, 34 men and 42 women (mean age 74.2)

from a retirement home nearby. The test for reliability was conducted four weeks before the test for validity. The participants were tested on two different days three days apart. They performed three different variations of the sit-and-reach in a counterbalanced rotating order, a chair sit and reach, a sit-and-reach and a back saver sit-and-reach. In the discussion it is explained that the sit-and-reach and the back saver sit-and-reach are the most common field measurements, but older adults have problems getting down and then up from the floor. The chair sit-and-reach was proposed as a valid alternative to assess hamstring flexibility. Results indicate that the chair sit-and-reach has good reliability and validity when compared to the other two measures. It is a safe and acceptable measure for older adults, and each leg can be measured separately.

Timed Up-and-Go

Rose et al.[59] assessed predicting the probability of falls in community-residing older adults using the timed 8 foot up-and-go. This test requires the seated

participants to rise from the chair, walk three meters (9.84 feet) to a line, return and sit down as fast as they can. Rikli and Jones[57] in 1999 found the distance to be too far to be performed at home, so the distance was shortened to eight feet (2.44 meters) and a cone replaced the line, so participants were required to walk around the cone. The Rikli and Jones protocol has been found both valid and reliable. With respect to the Rose et al[59] test, a total of 134 community dwelling adults (60-90 years), 71 adults (mean age 76.6 ± 6.2) who had not fallen in the past year and 63 adults (mean age 78.1 ± 6.2) with a history of two or more falls were recruited. Results showed that the mean result for the non-fall group was 8.2s, and for the previous fall group 12.3s. Any adult over 8.5s was classified as a faller, and this classification proved 86% correct. Of the non-fallers the prediction rate was 99%. Thus, the authors stated that they would recommend adoption of this functional mobility test as a valid and effective method to screen for disability and fall risk.

Dumbbell-curl, Back-Scratch, and Establishment of Normative Scores

Rikli and Jones[57] developed and validated the functional tests that will be used in this research to assess the functional mobility of independent older adults from 60 to 90 years of age. They initially used the disability model proposed by Nagi[46] in 1991. They refined and redefined the model based on their research[56] and found lifestyle/inactivity to coexist with disease pathology as a precursor to impairment. They developed functional tests to measure muscular strength (30s chair stand and arm curl), with the arm curl using eight pound weights for men and five pound weights for women. Endurance indicated by (6-min walk), flexibility (chair sit-and-reach and back scratch), power, speed, agility and balance (8 foot up-and-go). They also used body mass index for assessing the optimal (or at least manageable) size. They established the test-retest reliability and validity for their tests, and established normative scores for 5 year age group intervals based upon results for 7000 adults (ages 60-90+) at 267 test centers in 21 states.

Role of Exercise in Aging

Fiatarone-Singh[20] in a review article discussed the rationale for the use of exercise in optimizing aging with several participation outcomes. She wanted to minimize the physiological changes associated with aging, augment psychological health and well-being, increase longevity and decrease risk of chronic disease, using exercise as a primary or adjunct treatment for certain chronic diseases, and assist in the prevention of disability. Her conclusion is that these goals can only be reached with clear evidenced-based guidelines in combination with trained health professionals, and behavioral programs aimed at age-specific barriers and motivational factors.

Physiological Adaptations to Strength Training in Older Individuals

In a 10-year study of muscle strength changes in both men and women, Hughes et al.[26] found the expected declines in maximum dynamic force production. In contrast however, some of the subjects actually

increased strength during the follow up period alluding to the ability to modify muscle function with exercise.

Hunter et al[27] in a review titled "Effects of resistance training on older adults" found the evidence for resistance training in older adults was overwhelming. In his review he also found that strength will increase more than would be expected from a corresponding increase in muscle mass which he attributes to an increase in motor unit activation. His recommendations, taken from a meta-analysis by Rhea et al.[53] include strength training 2-3 days a week, 60% to 80% 1RM, 2-4 sets with 8-15 repetitions.

Roth et al.[61] investigated skeletal muscle satellite cell characteristics in 29 subjects, 14 young men and women (20-30 years) and 15 older men and women (65-75 years). They found that while satellite cells are important for muscle fiber regeneration and hypertrophy, they decline with age. In contrast however, after 9 weeks of heavy resistance strength training, the proportion of satellite cells increased

significantly in all groups, which also indicated increased levels of mitochondria.

Maintenance of Muscle Strength

Trappe et al.[70] studied the maintenance of whole muscle strength and size following strength training. Ten subjects (70 ± 4 years) began 12 weeks, 3 days per week progressive resistance training. Following the initial program, half the group completed 1 set at 80% 1RM for 10 repetitions, 1 day per week, while the other half returned to normal activities (no regular exercise). Researchers found that following a standard 3 day per week program for 12 weeks, maintenance of strength and size would only require 1 day per week at 80% of 1RM. In contrast to the active group, the control group which resumed normal activities (no regular exercise) showed significant losses.

Lemmer et al.[38] investigated 18 young (20-30 years and 23 older (65-75 years) subjects to determine whether resistance training and detraining levels in both groups affected muscular strength. The subjects

completed 9 weeks of unilateral knee extensions 3 days per week, followed by 31 weeks of detraining. They found that there was no significant decrease in muscular strength after 12 weeks of detraining in either group, and it was maintained above baseline even after 31 weeks. However the 1RM strength had declined dependent on age both before and after detraining. Once trained, older subjects responded as well as the younger ones.

Ivey et al.[29] studied the effects of training and detraining on muscle quality (alterations in neuromuscular, mechanical, contractile, and architectural components) in 11 men, and 9 women (20-30 years) and 11 men and 11 women (65-75 years). They used the same protocol as Lemmer et al.[38] with 9 weeks of unilateral knee extensions 3 days per week, followed by 31 weeks of detraining. The purpose of the study was to make age and gender comparisons for muscle quality in response to strength training. Muscle quality was defined as strength per unit volume in kg/cm^2. They found a significant increase of muscle quality with

strength training, and no significant decrease with detraining. However there was a definite age, time, and gender factor involved. The significance of this study was that the young women responded the best, older women the worst, with no difference between the men after 31 weeks of detraining.

Reliability of 1RM Testing

Phillips et al.[51] researched the reliability of maximum strength testing in older adults. They tested 16 men and 31 women (75.4 ± 4.7 years). 3 days were spent in testing familiarization, followed by 1RM chest press and seated leg press of 3 trials. They found that following the extensive familiarization systematic bias did not exceed 3.5% within the three tests. The final measure represented a random error of 3.6% which they did not consider meaningful. Their recommendation is that 1RM testing on older adults following a strict procedure will reduce systematic bias and random error, and provide a reliable basis for the detection of

clinically significant health or rehabilitation-related effects or relationships.

Aerobic + Strength Training

Ferrara et al.[19] studied the addition of a strength training component to an existing aerobic program, which at the time of the study, had consisted of treadmill walking 45 minutes per day, 2 days per week, for 6 months. The researchers then added 6 exercises (upper and lower body) of 15 repetitions on 2 other days per week. Strength and insulin sensitivity increased significantly in the combined aerobic plus strength training group, but not in the aerobic only group. However VO_{2max} decreased slightly (2.7 ± 0.1 vs. 2.4 ± 0) in the combined strength plus aerobic training group but remained steady in the aerobic only group. With regard to the increased insulin sensitivity, the authors state that further research is needed to know whether the effect of the addition of strength training to an aerobic program is additive or synergistic.

Aerobic Exercise Training

Beere et al.[4] stated that aerobic exercise training can reverse age-related peripheral circulatory changes in healthy older men. They tested 10 older subjects (mean age 66 ± 4.4 years) and 13 younger subjects (mean age 28 ± 6.7 years) with invasive measurement of central and peripheral cardiovascular responses during cycle exercise before and after 3 months of training. At baseline, they reported that cardiac output and a-VO_2 difference during exercise were significantly lower in the older subjects. However with training, the older group increased systemic arterio-venous O_2 difference by 14.4%, and VO_{2max} by 17.8%. Peak cardiac output remained unchanged, but peak leg blood flow increased by 50% in the older subjects. Their conclusion is that the age-related decline in VO_{2max} results from a reversible deconditioning effect on the distribution of cardiac output to exercising muscle and an age-related reduction in cardiac output reserve.

Kyle et al.[36] studied 3549 Swiss men, and 3184 Swiss women for aging, physical activity, and height-

normalized body composition parameters. The participants were classified as physically active (at least 3h/week) or sedentary. Men over 85 years and women over 75 years could not be evaluated because they did not meet the physical activity criteria. For the rest (25-74 years of age) they found that physically active adults were significantly less likely to have a low or high fat free mass index, and less likely to have a high or very high body fat mass index, and more likely to have a low body fat mass index when compared to the sedentary participants. They also report in contrast to common claims that fat free mass decreases with age and is stable until 74 years of age. However, they found that the body fat mass index was higher in older groups.

Role of Muscle Size Response to Strength Training

Roth et al.[62] studied 8 men, 6 women (20-30 years) and 9 older men, 10 women (65-75 years who completed a 6 month 3 day per week strength training program, for the upper and lower body. The cross- sectional area of

the thigh and quadriceps muscle was measured by MRI pre-and post-training. Both groups had significant increases in muscle volume with no differences between or among the groups. They therefore conclude that following whole body strength training, neither age nor gender affects the results.

Role of Metabolic Rate in Strength Training

Hurley and Roth[28] found that almost 2 decades of age-associated losses in mass and strength could be regained with heavy resistance strength training (>30% 1RM) and that insulin sensitivity can also be increased. They also found evidence of a possible increase in resting metabolic rate in men but not women, and the attenuation of losses in bone mineral density. There was no documented effect on total body fat or intra-abdominal fat, as well as falls and flexibility. However with respect to falls, several risk factors were reduced.

Lemmer et al.[39] studied the effects of gender, age, and strength training on resting metabolic rate. They

showed that the changes in the resting metabolic rate (RMR), when corrected for changes in fat free mass (FFM) that resulted from strength training, are specific to gender, but not to age. They tested 10 men and 10 women 20-30 years of age against 11 men and 10 women 65-70 years of age before and after 24 weeks of strength training. The RMR increased significantly in men for both age groups, and although the women in both age groups did increase their RMR it was not significant.

Role of Recovery in Strength Training

McLester et al.[43] studied the muscular endurance recovery rates of 10 young men (<30 years), vs. 10 older men (>50 years), after 3 sets of isometric exercises to failure. The purpose of their study was to find a standardized test for recovery time before beginning a strength training program. At 24 hours there was no substantial recovery. At 48 hours only 30% were above baseline, and at 72 hours all were at or near baseline with 80% of the younger subjects above.

At 96 hours subjects were at, but still not significantly above baseline. The authors concluded that older exercisers may need to increase their recovery time and not work every other day. It was also suggested that this protocol could be used for baseline testing.

Strength Training Effects on Muscle Characteristics

Hikida et al.[25] investigated the effects of high intensity training on untrained older men as well as their muscle fiber characteristics. Eighteen men (58-78 years) were split into training or control groups. The training group completed 3 progressive lower body exercises at 80-85% 1RM and 10 repetitions each for 16 weeks. Biopsies were taken and muscle fiber typing was begun. The percent of IIB fibers was significantly decreased while the percent of IIA fibers was significantly increased with no effect on type I. However, all three fiber types were significantly larger after training. Muscle weakness in aging is the result of the decreased number of muscle fibers and the

loss of motor units. With this study, it was shown that strength training can slow or even partially reverse the age-related decreases. The fiber sizes examined in the elderly men after training were of the same size as young sedentary men.

Hagerman et al.[24] investigated the effect of high intensity resistance training on strength, cardiovascular and metabolic responses. Eighteen untrained men (60-75 years) were recruited. Nine were randomly put into the training group, and nine were placed in the control group. The training group completed 16 weeks of high intensity strength training at 85-90% 1RM. At the end of the study, biopsies were taken from the vastus lateralis. Pre and post training blood samples were analyzed for serum lipids. Exercise metabolism, ECG, and blood pressure were also observed during a treadmill test. In the training group significant decreases were noted in percent body fat, and increases were noted in percent type IIA fibers. Cross sectional area of all fiber types (I, IIA, IIB) increased significantly and the capillary to fiber

ratio increased but not significantly. The training group also increased treadmill performance and VO_{2max}. These results show that skeletal muscle in older, untrained men will respond with significant strength gains with considerable increases in fiber size and capillary density. VO_{2max} and serum profiles also benefited from the training. Their final statement is that older men will not only tolerate very high intensity work loads but will exhibit intramuscular, cardiovascular, and metabolic changes normally associated with younger subjects.

Psychology and Aging

Depression

Singh et al.[66] investigated 32 clinically depressed participants, 12 men and 22 women (71.3 ± 1.2 years) to assess the efficacy of exercise as a long term antidepressant in elderly subjects in a 20 week randomized control trial with a follow up at 26 months. During the phase I, the exercise group engaged in high intensity progressive resistance training 3 days per

week for 10 weeks at 80% 1RM for 3 sets of 8 repetitions. The control group watched supervised health education videos for 1 hour twice a week. During the 10 week phase II, the exercisers continued, but on their own with 97% compliance. At 20 weeks they were let go with no specific instructions. At the 26 month follow up, 33% were still involved with weight training at least two days a week. The exercise group showed significantly reduced depression at 20 weeks and 26 month follow up. They also showed significantly increased self efficacy for jogging. The researchers concluded that clinical depression had been resolved in 73% of the exercisers, compared with 36% of the controls. They also stated that exercise seems to act as an antidepressant on the biological, cogitative, behavioral systems. Finally they feel that unsupervised resistance training seems to be feasible and safe, which lays the foundation for future research.

Health and Function

DiPietro[16], in a review article, investigated physical activity in aging, changes in patterns and their relationship to health and function. She defined the basis of physical activity as physiological, where heredity and genetic predisposition play an important role, as well as speed, flexibility, balance, strength, psychosocial (which encompasses motivation), stress tolerance, social adequacy, and independence. Knowledge and beliefs about exercise relate to the benefits of physical activity, along with perceived enjoyment. Social support, including peer reinforcement is also important. Finally there are environmental concerns, which include safety and accessibility. All these factors put together seem to influence the exercise behavior of the older population.

Theory of Planned Behavior

Conn et al.[14] studied older women and exercise in the context of the theory of planned behavior beliefs. The opening statement is a telling one where they state

that despite the benefits of exercise, aging women remain largely sedentary. The theory of planned behavior hypothesizes that the intention to perform and actual performance are determined by three independent factors; Attitude (toward the behavior), subjective norms (other people approve or disapprove of the behavior), and perceived control (ease or difficulty in performance). Their main purpose was to identify the theory's construct validity, and secondarily to determine if specific beliefs predicted exercise behavior. They tested 225 women (65-92 years of age) to measure the theory. The study's results partially support the theory of planned behavior as it applies to exercise for older women. The importance of perceived control (perceived barriers to exercise) is consistent with other research. In this study normative beliefs predicted exercise intention but not behavior which is also consistent with the literature. Attitude, in this case, commitment to exercise and exercise behavior, was consistent with the literature. The authors state that

more studies of older women are needed because that group is most at risk for lack of exercise.

Quality of Life

Rejeski and Mihalko[52] attempted to define quality of life in a review article. They state that in mainstream psychology, it is defined as a conscious cognitive judgment of satisfaction with one's life[49]. In aging research, quality of life has been used an overall term to describe what clinicians believe are important in the lives of their aging patients. However, they again state that the only plausible definition to elevate the term to the status of a psychological construct is the one proposed by Pavot and Diener[49] above. It is important that the elevation happens because once we understand the mediating and moderating variables on quality of life, implementation and promotion of physical activity may be more easily designed.

Balance and the Risk of Falls

Buchner et al.[11] compared three types of endurance training on balance and other fall risk factors such as endurance, strength, gait and health status. Their study was part of the National Institute on Aging frailty and injury cooperative studies of intervention techniques. The test was conducted on 181 older adults with 30 in the control group, 24 is the stationary cycle group, 26 in the walking group, and 26 in the aerobic movement group. Exercise was conducted for 3 months, 3 days per week for one hour per day at 75% heart rate reserve, where the maximum heart rate was determined by treadmill test. They concluded that walking appeared to have the greatest benefit on all fall risk factors. The walking group increased VO_{2max} by 18%, the distance walked on a 6″ balance beam, and gait speed by 4 meters per minute. All results were significant. However, as a caution, the authors suggest that endurance training and balance training cannot be successfully integrated, but recommend further studies in this area.

Rubenstein et al.[64] investigated the effects of a group exercise program on strength, mobility, and falls among fall-prone elderly men. Fifty nine men (mean age 74 years) with a history of gait and fall problems were assigned to a control group (n = 28) or to a 12-week exercise program (n = 31). The exercise sessions were performed for 90 minutes, 3 times a week to increase strength and endurance as well as mobility and balance. The results indicate that the exercisers showed significant improvements in measures of gait and endurance. The findings seem to indicate that that exercise can improve function in fall-prone elderly persons.

Role of Training for Activities of Daily Living

Chair Rise Biomechanics

Alexander et al.[1] investigated the effects of functional ability and training on chair-rise biomechanics in older adults. Thirty men were recruited. Sixteen men (mean age 82 years) were strength trained 1 hour per day, 3 days per week, for

12 weeks. Fourteen men (mean age 84 years) served as a control group and were flexibility trained. After the training period, all participants were required to complete seven chair-rise tasks. These included chair-rise with and without hands, with lowered seat height, with increased speed and with limited foot support. The researchers found that the ability to generate momentum and torque was particularly low for the more functionally disabled. This result fits with the models of chair rise performance in impaired adults. The training group, even though they did not significantly improve their success, demonstrated a trend toward increased vertical and horizontal momentum, greater extension and greater torque. Although the changes were small, short term training did show improvement. The authors concluded that a longer term resistance training study needs to be implemented.

Sit-to-Stand Performance

Lord et al.[41] studied the sit-to-stand performance as related to sensation, speed, balance, and

psychological status which are required in addition to strength. They recruited 669 community dwelling older adults consisting of 233 men and 436 women (mean age 78.9 ± 4.1 years) who were tested for strength, vision, peripheral sensation, reaction time, balance, health status, and sit-to-stand performance. They found that sit-to-stand performance was significantly associated with sensorimotor, balance, and psychological factors. Specifically, they found that visual contrast sensitivity, lower limb proprioception, tactile sensitivity, simple foot reaction time, postural sway, body weight, reported pain, anxiety, and vitality, in addition to knee extension, knee flexion and ankle dorsiflexion strength were significant and independent predictors of sit-to-stand performance. Quadriceps strength had the highest beta weight in the regression model which is consistent with previous findings that strength is more important than balance in predicting sit-to-stand performance. They concluded that sit-to stand performance is influenced by multiple sensorimotor, balance, and psychological factors and

represents a particular transfer skill rather than a proxy measure of lower limb strength. These findings have implications for exercise interventions.

Walking Performance and Cardiovascular Response

Newman et al.[48] as part of the Health, Aging and Body Composition Study investigated walking performance and cardiovascular response and its association with age and morbidity. The study population consisted of 2324 older adults, 1189 men and 1135 women (73.5 ± 2.9 years in age). Participants were asked to walk 400 meters (1312.4 feet or ¼ mile). Unlike the 6-minute walk which holds time as a constant, distance was the constant in this study. To that end, 76% completed the full 400 meters with an average time of 5 minutes and 20 seconds. It was noted that times were slower in each age group. BMI for analysis was replaced with body composition consisting of total fat mass, bone free lean mass, and height. Moving average plots suggested that walk time was best in the percent body fat range of 19% to 27% in men and 28% to 37% in women. In the

final model, walk time was significantly and independently related to the square of the fat mass but not to height or lean mass. Clinically, they also measured heart rate since a higher heart rate and slow heart rate recovery have been associated with future cardiovascular problems. They measured the double product (systolic blood pressure and heart rate) which is thought to represent myocardial oxygen consumption. All this was done in an effort to determine the clinical significance of the test. They suggest that use of this test in clinical practice might raise awareness conveying the extent older adults may be impaired in terms of walking performance.

Intervention Strategies

Bemben[6] in a review article on age-related alterations in muscular endurance, stated that the maintenance of some appropriate level of neuromuscular function with aging is critical if we expect the elderly to maintain some semblance of normal daily activity and functional independence. In his conclusion

he stated the need for research into the development of an effective training program for the elderly. The ideal exercise program is one that balances the twin risks of inactivity and exercise. The program he envisions would consider the social needs of an older population, as well as their goals and reasons for participation. We cannot continue to use programs developed for the younger generation. He suggests that we compare the effects of aerobic and resistance protocols on muscular endurance, (which represents a measure of functional capacity) and alter the intensity, frequency, and duration of training to ensure adherence and compliance. Finally, he states that it must be applied in order to be beneficial to functional activities such as balance, gait, and coordination so that sarcopenia and falls can be reduced.

Fiatarone Singh[21] in a review article presents a rational for the use of exercise and physical activity for health promotion and disease prevention in the older population. She believes that regular physical

activity or exercise can minimize the changes associated with aging, decrease the risk of many chronic diseases, counteract the side effects of medical treatment, and assist in the prevention of disability. Her recommendations include exercise being integrated into standard health care modalities, rather than being a separate entity. Attention must be paid to demographics, health status and societal influences where exercise behavior is concerned, and a concrete plan to change them. This will require training of physicians in the basics of exercise prescription and the resulting quality of life benefits.

King et al.[34] studied the comparative effects of two physical activity programs. Older adults (n = 103), (67 women and 36 men all aged 65+) were divided into groups; a moderate-intensity endurance plus strengthening exercise group and a stretching plus flexibility exercise group. These groups were further subdivided into class sessions and home sessions. There were 3 assessments, initial, 6 months, and 12 months. Exercise adherence was 79% for the class strength

sessions and 80% for the class flexibility sessions. However, the home based programs had adherence rates of 92% for strength and 92% for flexibility. All participants were regularly contacted by trained health educators throughout the program to encourage participation and problem solving. As a result, they demonstrated that community based physical activity programs can be delivered in a combination of formats, but the challenge remains for long term adherence.

Adherence

McAuley et al.[42] tested 174 older adults (mean age 66 years) for adherence in a 6-month controlled trial with an 18 month follow up. They examined the role that social, behavioral, & cognitive determinants have for long term physical activity in older adults. They examined their results using the social cognitive theory. Self-efficacy was the most important variable followed closely by social support. The authors state that the results, which examined the mediating variables in predicting and understanding physical

activity behavior, need to be continuously examined if we are to design successful interventions.

Stewart et al.[68] examined the effectiveness of the Community Health Activities Model Program for Seniors (CHAMPS II program) to increase lifetime physical activity levels. 164 subjects, 34% men and 66% women (mean age 74) completed the trial. There were 81 subjects in the intervention group and 83 in the control group. The control group changes were negligible, but the intervention group increased overall calorie expenditure by 687 kcal/week. The program did what it was designed to do in terms of promoting increases in physical activity, and it translated to the community setting.

Summary

As discussed already, strength training is a viable option for decreasing functional limitations[9,44], as well as slips and falls[12,64]. It was shown to increase muscle strength[27], cross sectional area[23], size[62], and altering fiber type characteristics[24,25]. Strength

training also has a positive effect on insulin sensitivity[19], which has implications with regard to type II diabetes, and it was shown that muscle strength was a significant predictor of all cause mortality in adults over 60 years of age[44].

CHAPTER III

Manuscript

Abstract

Purpose: The goal of this study was to examine the physical effects of a two-year peer-led resistance training and aerobic program in a group of community dwelling older adults.

Methods: Nine community-dwelling older adults (Age = 81.2 ± 7.1 yrs; Males = 1, Females = 8) were trained for six weeks, monitored and corrected for one year, and then completed two years of peer-led weight training three days/week. Pre and post training physical function assessments included 6-minute walk distance (endurance, functional mobility and gait speed), 8 foot timed up-and-go (balance and agility), back scratch (shoulder flexibility), sit-and-reach (flexibility), number of chair stands in 30 seconds (lower-body muscular endurance), number of arm curls in 30 seconds (upper-body muscular endurance). Data were analyzed by repeated measures ANOVA.
Results*:* There were no significant differences found between post-test 1 and post-test 3 in any of the measures. Any small decreases in the results can be accounted for by the increasing age of the individuals involved over the testing period. The preliminary results are as follows

1. 6-minute walk (-13 meters in 6-min)
2. 30 sec Arm Curls (+3.5 curls in 30 sec)
3. 8' up-and-go (-0.6 seconds over 8 feet)
4. Chair Stands in 30 sec (-0.55 stands in 30 sec)
5. Sit and Reach (-0.17 inches)
6. Back Scratch (-1.17 inches)

Conclusions: The results of this project suggest that a peer-led physical conditioning program is an effective approach for maintaining the physical functioning of community-dwelling older adults.

Introduction

The lack of physical activity in our expanding older population is a major public health problem. By 2030 there will be more than 70 million Americans over the age of 65, representing 20% of the U.S. population[71]. It is well known that physical inactivity contributes to disability and reduced quality of life in older adults. The challenge then, is to translate our ever increasing knowledge-base into practical, accessible, enjoyable, and effective physical activity programs for those older adults.

In a search of the literature, we found no studies examining the use of peer leadership for a dumbbell strength training program with community dwelling older adults. By effectively training older adults to lead other older adults, one could gain an exercise leader with peer respect, empathy, and an inherent understanding that is absent when a younger person attempts to train the same group. It is critical to find a way to disseminate practical information on the

health benefits of exercise and peer leadership could be a step in the right direction.

Most of the past research on exercise training in the elderly has focused on the aerobic training component, but recent literature has shown that strength training can mitigate the effects of sarcopenia, slips and falls, osteoporosis, and osteoarthritis, as well as enhance the ability to perform the basic activities of daily living such as carrying groceries, gardening, or just rising from a chair without help or pain[1,10,12,41,63,64].

Therefore, we hypothesized that if a certified strength trainer led a one-year strength training program for a group of community dwelling older adults, and then designated peer leaders continued the program for the next two years, participants would be able to maintain some of their strength gains.

Methods

Participants

Participants were recruited from a community nutrition center sponsored by the Georgia Department of Human Resources, COOSA Valley Rural Development Corporation (RDC), and the Rome Area Agency on Aging. All attending seniors were invited to participate in the study if they were functionally mobile, free from any serious cardiovascular problems and other illness that would limit their activity. This was followed by a standard health history, and informed consent form. Participants were screened for heart disease and/or palpitations, blood pressure, cholesterol, asthma, diabetes, arthritis, shortness of breath, back injuries, joint injuries, hernia, epilepsy, allergies and fatigue or dizziness. In addition all participants were required to have physician approval and they each signed a consent form prior to beginning the sessions. The initial study received approval from the Institutional Review Board of Kennesaw State University; the follow-up study reported on in this

thesis received additional approval from the institutional review board of The University of Tennessee.

Time Line

Pre-test (March 2002), post-test 1 (May 2002), post-test 2 (June 2003), post-test 3 (June 2005).

Testing Protocol

Twelve participants (Age = 81.2 ± 7.1) finished the initial one-year study (males = 2, females = 10). Of those, nine participants (male = 1, females = 8) finished the three year protocol. These individuals performed a series of pre and post-test requirements including 6-minute walk distance[55-58] (endurance, functional mobility and gait speed), timed eight-foot up-and-go[56-58] (balance and agility), number of chair stands in 30 seconds[30,57,58] (lower-body muscular endurance), and number of arm curls in 30 seconds[57] (upper-body muscular endurance), chair sit-and-reach[31,

[57,58] (flexibility), and back scratch in inches of distance between hands[57,58] (shoulder flexibility).

The initial pre-test was followed by three days of familiarization, one hour per day, using 1-lb weights to instruct participants about the exercises to be used, the muscles affected, potential benefits derived, and the proper form with which to execute the exercises. Participants were required to do ten minutes of stretching both pre and post-exercise, as well as walk around the facility to warm up and/or cool down. In addition, participants were asked to walk at least 30 minutes per day on most days of the week as recommended by the Surgeon General[72].

Following the initial period, the participants engaged in a six week strength training program, (3 days per week) for one hour each day. Each participant chose weights ranging from 1 to 10 pounds for the first day, and this starting weight was then recorded as a baseline. The participants were seated in a row on folding metal chairs with rubber anti-skid pads to prevent movement. They were then instructed to perform

10 repetitions with the chosen weight for each of the following exercises: Bicep curl, triceps kickbacks, medial deltoid raises, and bent over rows, to promote upper body strength. They also performed the seated leg raise and hold for 15 seconds, seated calf raises, and chair stands to promote lower body strength; sit and reach and "back scratches" to improve flexibility. At the end of week two, all participants who could easily do the ten repetitions with the original weight were asked to increase their weights. The new weight was recorded and week three began. Again at the end of week four, they increased their weights, and maintained that weight to the end of the initial post-test period following week six.

At the end of week six, the initial post-test was conducted. During the first year of the program, the participants exercised three-days per week for one-hour per day and they were encouraged to increase their weights if possible at six-week intervals. For each exercise period they completed 2-sets of 10-repetitions for each exercise consisting of bicep curls, triceps

kickbacks, shoulder presses, front rear and side arm raises, bent over rows, wrist curls, leg raises, calf raises, and chair stands. At the end of the first year, the same tests performed at baseline were repeated.

In June 2002, the two peer exercise leaders (one male age 84 years of age, and one female age 76 years of age) were trained to take over the group for the next year with monthly guidance from the instructor, and in June 2003 the peer leaders were the primary instructors until June 2005 when the final post test was completed.

Statistical Method

Statistical analyses were accomplished with a repeated measures ANOVA ($p<0.05$) using the commercially available SPSS© for Windows, along with the EM function for missing data points, release 11.0.1 (15 Nov 2001) software.

Results

Physical Characteristics

Nine participants (age = 81.2 ± 7.1 yrs; Males = 1, Females = 8) completed the study and were included in the analysis. They ranged from 70 to 95 years of age. All participants lived in the surrounding community and functioned independently outside the community center on a daily basis. They gathered at the center daily for the noon meal, and three times a week for exercise training. Only three participants of the nine were impaired in any way. A 95 year old woman used a cane, an 81 year old used a walker, and an 89 year old had difficulty from arthritis.

The repeated measures ANOVA indicated the result significance as follows, 6-minute walk (p=0.713), arm curls (p<0.001*) chair stand (p=0.144), 8-foot up-and-go (p=0.254), sit-and-reach (p=0.270), and back scratch (p=0.089). The repeated measures ANOVA is presented in table 8 and tables 2-9 are presented in appendix (C). Raw scores for all measures and normative data from Rikli and Jones[58] "Functional fitness normative scores"

are presented in tables 2-7. A Tukey post hoc analysis (table 9) was run on all arm-curl data sets.

With regard to the statistics, there were no significant differences (except for the arm-curls) between the pre-test and post-test 3. When the arm-curl pre-test was compared against post-test 1, 2, and 3, and also post-test 1 against post-test 2, there was a significant difference ($p<0.001$).

Table 1 shows the mean and standard deviation scores for all the tested measures across time. For the 6-minute walk, Table 1 shows that from post-test 1 to post-test 3 there was a decline of 13 meters in distance walked during the 6-minute walk. For arm-curls there was an increase of 3.55 arm-curls in 30-seconds over the same period of time. Chair stands decreased by a mean of 0.55 stands in 30-seconds while the timed 8-foot up-and-go decreased by a mean of 0.6 seconds. Chair sit-and-reach decreased by a mean of 0.17 inches in distance (fingers to toes), but most participants improved slightly or stayed the same. The back scratch test in distance between fingers decreased by a mean of

Table 1: Changes in tests of physical function resulting from strength training in community dwelling older adults

Tests	Pre	Post 1	Post 2	Post 3	Description
6-Min Walk	114.63	132.07	119.04	119.07	Feet walked in
Std Deviation	±42.14	±72.39	±90.98	±55.18	6-minutes
Arm Curls	10.89*	18.67*	17.44*	22.22	Number of Arm-Curls
Std Deviation	± 4.14	± 4.00	± 4.65	± 4.87	in 30 seconds
30s Chair Stands	7.89	9.33	8.89	8.78	Number Chair Stands
Std Deviation	± 3.86	± 3.87	± 1.90	± 6.04	in 30 seconds
8' up-&-go	10.65	8.52	7.58	9.12	Time in seconds
Std Deviation	± 4.81	± 4.02	± 2.59	± 4.46	
Sit & Reach	- 0.44	0.67	0.89	0.5	Distance in inches
Std Deviation	± 1.88	± 0.83	± 1.11	± 0.71	to toes
Back Scratch	- 6.56	- 2.61	- 0.44	- 3.78	Distance in inches
Std Deviation	± 6.28	± 3.32	± 2.36	± 5.73	between fingers

* Significant difference from Pre-Test
Data expressed as mean and ± standard deviation
Note: The negative numbers in the sit & reach and back scratch tests indicate failure to reach either toes or fingers. Positive numbers indicate an overlap.

1.17 inches, indicating that flexibility had decreased, but not significantly, and all but one of the participants were still above their pre-test values and had increased their normative scores.

Overall the standard deviations in post-test 3 were larger than post-test 1 which seems to indicate that some of the participants had lost more than others. However in the case of the 6-minute walk and sit-and-reach tests, the standard deviation was smaller at the end of the test which indicates more homogeneity among the group.

With regard to the significant improvement found in the arm-curl test, it may indicate that neural adaptation[27,33,65,67] inherent to an initial training program was the major contributor to the gains that were accomplished during the first time period. Another conclusion for the gains over that period would be that the competitive nature of subjects regardless of age and the ease of the movement that contributed to the outcome as much as other factors.

Discussion

The purpose of this research was to show the effectiveness of a peer-led strength training program for community dwelling older adults. The study shows that there was no significant decline over time in any of the measures regardless of leadership. The normative data comparison indicates that 5 of the 9 participants improved in the 6-minute walk (endurance), all 9 participants improved arm-curls (upper body strength), 7 participants improved or stayed the same in the chair-stand (lower body strength), 7 participants

improved in the 8 foot up-and-go (power, speed, agility and balance), 7 participants improved or stayed the same for the sit-and-reach measure (hamstring flexibility) and 8 participants improved in the back-scratch(shoulder flexibility).

The comparison against the normative scores is significant, because it demonstrates that once trained, a community dwelling older adult population can maintain their strength gains with peer leadership. This would indicate that certified fitness instructors can initially train these populations, assign peer leaders and let them continue the intervention. This enables a wider access to community groups and could ultimately help to reach more people.

One factor that may have contributed to this outcome would be the conclusion of DiPietro[16] that social support, perceived enjoyment, and peer reinforcement contributed a substantial amount. The participants in this group come from the same small community, attend the same church and social functions, and are all aging together.

Arm-curls and chair stands are measures of strength. Strength is needed for performing activities of daily living. However, as we age we may become functionally limited. To reverse such limitations, strength must increase.

Two studies have shown the importance of strength on functional limitations over time. In a 5 year muscular strength and physical function study of 3069 men and 589 women Brill et al.[9] found that those adults in the high strength group had a lower incidence of functional limitations. However, Metter et al.[44] investigated 1071 men over 25 years, and found that the loss of strength in men over 60 years of age was more important than the actual strength level in predicting all-cause mortality.

Strength and muscle cross sectional area decline naturally with normal aging due to a decreased number of muscle fibers and loss of motor units. Hikida et al.[25] found that this decline can be slowed and even partially reversed with strength training. The percentage of type IIb fibers decreased, and % type IIa

increased significantly, while type I remained the same. All three fiber types I, IIa, and IIb were significantly larger after training. In another study, Hagerman et al.[24] investigated the effect of high intensity resistance training on untrained older men. They found significant increases in the cross sectional area of all fiber types, as well as the capillary to fiber ratio. They show that skeletal muscle in older, untrained men will respond with significant strength gains and with considerable increases in fiber size and capillary density. Although the present study did not assess changes in skeletal muscle characteristics, the above-mentioned studies provide plausible mechanisms for the improvements in strength from pre-test to post-test 1.

Slips and falls in the elderly are also a major problem, and can result from lack of leg strength and endurance. We used the Jones[30] chair stand protocol to reduce the number of slips and falls which somewhat follows a study by Rubenstein et al.[64] who investigated 59 community dwelling older men all with leg weakness,

impaired gait and balance, and a history of falls. The exercise group showed improvement in gait and endurance measures, and increased their chair stand performance by 23 percent.

Lower body interventions included chair sit-and-reach training[31] as another measure to reduce slips and falls, because older adults may have problems getting up and down from the floor. This test was designed to assess hamstring flexibility, and by doing the sit-and-reach three days a week, the participants have kept most of their gains.

We also assessed agility and balance with the timed 8-foot up-and-go test[57,59] and our participants were able to initially strengthen and maintain part of their initial strength gains. Rose[59] showed that any adult completing the 3-meter course over 8.5 seconds (6.91 seconds for 8 feet or 2.44 meters) was at increased risk for falling, and we had five participants fitting into that category. Of the five, two were within 0.5 seconds of the 6.91 second goal, one participant age 95 used a cane, one age 89 had a

knee problem and one age 81 used a walker. The other participants whose ages ranged from 70 to 84 years of age were well under the time limit. Finally, the participants seemed to enjoy the exercise, worked together to overcome difficulties, encouraged each other, and strived to maintain their strength gains.

This research provides preliminary evidence that a peer-led strength training program for community dwelling older adults is effective and feasible. The peer-led strength training program enabled them to maintain part of the strength gains that they derived from the initial year-long training program. Additional research is needed on a larger population to validate the results.

REFERENCES

1. Alexander, N., Gross, M., Medell, J., Hofmeyer, M. Effects of functional ability and training on chair-rise biomechanics in older adults. *J Gerontol A Biol Sci Med Sci*. 56:M538-547, 2001.
2. Bassuk, S. S., Manson, J.E. Epidemiological evidence for the role of physical activity in reducing risk of type 2 diabetes and cardiovascular disease *Journal of applied physiology*. 99:1193-1204, 2005.
3. Basu, R., Basu, A., Nair, K.S. Muscle changes in aging. *The journal of nutrition, health & aging* 6:336-341, 2002.
4. Beere, P. A., Russell, S.D., Morey, M.C., Kitzman, D.W., Higginbotham, M.B. Aerobic exercise training can reverse age-related peripheral circulatory changes in healthy older men. *Circulation* 100:1085-1094, 1999.
5. Bellew, J., Yates, J., & Gater, D. The initial effects of low-volume strength training on balance in untrained older men and women. *Journal of strength and conditioning research*. 17:121-128, 2003.
6. Bemben, M. G. Age-related alterations in muscular endurance. *Sports medicine* 25:259-269, 1998.
7. Biddle, S., Nigg, C. . Theories of exercise behavior. *International Journal of Sport Psychology*. 31:290-304, 2000.
8. Brill, P. A., Cornman, C.B., Davis, D.R., Lane, M.J., Mustafa, T., Sanderson, M., Macera, C.A. The value of strength training for older adults. *Home care provider* 4:62-66, 1999.
9. Brill, P. A., Macera, C.A., Davis, D.R., Blair, S.N., Gordon, N. Muscular strength and physical function. *Medicine and science in sports and exercise* 32:412-416, 2000.
10. Buchner, D., Cress, M., Esselman, P., Margherita, A., de Lateur, B., Campbell, A., Wagner, E. Factors associated with changes in gait speed in older adults. *J Gerontol A Biol Sci Med Sci*. 51:M297-302, 1996.
11. Buchner, D. M., Cress, M.E., de Lateur, B.J., Esselman, P.C., Margherita, A.J., Price, R., Wagner, E.H. A comparison of the effects of three types of endurance training on balance and other fall risk factors in older adults. *Aging (Milano)*. 9:112-119, 1997.

12. Buchner, D. M., Cress, M.E., de Lateur, B.J., Esselman, P.C., Margherita, A.J., Price, R., Wagner, E.H. The effect of strength and endurance training on gait, balance, fall risk, and health services use in community-living older adults. *The journals of gerontology. Series A, Biological sciences and medical sciences*. 52:M218-224, 1997.
13. Charette, S., McEnvoy, L., Pyka, G., Snow-Harter, C., Guido, D., Wiswell, R., et al. . Muscle hypertrophy response to resistance training in older women. *Journal of applied physiology*. 70, 1991.
14. Conn, V., Tripp-Reimer, T., Maas, ML. Older women and exercise: theory of planned behavior beliefs. *Public health nursing*. 20:153-163, 2003.
15. Cress, M. E., Conley, K.E., Balding, S.L., Hansen-Smith, F., Konczak, J. Functional training: muscle structure, function, and performance in older women. *The Journal of orthopaedic and sports physical therapy*. 24:4-10, 1996.
16. DiPietro, L. Physical activity in aging: Changes in patterns and their relationship to health and function. *J Gerontol A Biol Sci Med Sci*. 56:13-22, 2001.
17. Doherty, T. J. Invited review: Aging and sarcopenia. *Journal of applied physiology*. 95:1717-1727, 2003.
18. Evans, W. J. Reversing sarcopenia: how weight training can build strength and vitality. *Geriatrics*. 51:46-47, 51-53, 1996.
19. Ferrara, C. M., McCrone, S.H., Brendle, D., Ryan, A.S., Goldberg, A.P. Metabolic effects of the addition of resistive to aerobic exercise in older men. *International journal of sport nutrition and exercise metabolism*. 14:73-80, 2004.
20. Fiatarone-Singh, M. A. Exercise and aging. *Clinics in geriatric medicine*. 20:201-221, 2004.
21. Fiatarone-Singh, M. A. Exercise Comes of Age: Rationale and Recommendations for a Geriatric Exercise Prescription. *The journals of gerontology. Series A, Biological sciences and medical sciences*. 57:M262-M282, 2002.
22. Fiatarone, M., Marks, E., Ryan, N., Meridith, C., Lipsitz, L., & Evans, W. High intensity strength training in nonagenarians. . *Journal of the American Geriatrics Society*. 263:3029-3034, 1990.

23. Frontera, W. R., Hughes, V.A., Fielding, R.A., Fiatarone, M.A., Evans, W.J., Roubenoff, R. Aging of skeletal muscle: a 12-yr longitudinal study. *Journal of applied physiology* 88:1321-1326, 2000.
24. Hagerman, F., Walsh, S., Staron, R., Hikida, R., Gilders, R., Murray, T., Toma, K., Ragg, K. Effects of high-intensity resistance training on untrained older men. I. Strength, Cardiovascular, and Metabolic Responses. *J Gerontol A Biol Sci Med Sci*. 55:B336-346, 2000.
25. Hikida, R., Staron, R., Hagerman, F., Walsh, S., Kaiser, E., Shell, S., Hervey, S. Effects of high-intensity resistance training on untrained older men. II. Muscle Fiber Characteristics and Nucleo-Cytoplasmic Relationships. *J Gerontol A Biol Sci Med Sci*. 55:B347-354, 2000.
26. Hughes, V., Frontera, W., Wood, M., Evans, W., Dallal, G., Roubenoff, R., Fiatarone-Singh, M. Longitudinal muscle strength changes in older adults: Influence of Muscle Mass, Physical Activity, and Health. *J Gerontol A Biol Sci Med Sci*. 56:B209-217, 2001.
27. Hunter, G. R., McCarthy, J.P., Bamman, M.M. Effects of resistance training on older adults. *Sports medicine*. 34:329-348, 2004.
28. Hurley, B. F., Roth, S.M. Strength training in the elderly: effects on risk factors for age-related diseases. *Sports medicine* 30:249-268, 2000.
29. Ivey, F., Tracy, B., Lemmer, J., NessAiver, M., Metter, E., Fozard, J., Hurley, B. Effects of Strength training and detraining on muscle quality: Age and gender comparisons. *J Gerontol A Biol Sci Med Sci*. 55:B152-157, 2000.
30. Jones, C. J., Rikli, R.E., Beam, W.C. A 30-s chair-stand test as a measure of lower body strength in community-residing older adults. *Research quarterly for exercise and sport* 70:113-119, 1999.
31. Jones, C. J., Rikli, R.E., Max, J., Noffal, G. The reliability and validity of a chair sit-and-reach test as a measure of hamstring flexibility in older adults. *Research quarterly for exercise and sport* 69:338-343, 1998.
32. Kamel, H. K. Sarcopenia and aging. *Nutrition reviews*. 61:157-167, 2003.

33. Kamen, G. Aging, resistance training, and motor unit discharge behavior. *Canadian Journal Applied Physiology*. 30:341-351, 2005.
34. King, A., Pruitt, L., Phillips, W., Oka, R., Rodenburg, A., Haskell, W. Comparative effects of two physical activity programs on measured and perceived physical functioning and other health-related quality of life outcomes in older adults. *J Gerontol A Biol Sci Med Sci*. 55:M74-83, 2000.
35. Klein C, A. B., Marsh G, Rice C. Muscle size, strength, and bone geometry in the upper limbs of young and old men. *The journals of gerontology. Series A, Biological sciences and medical sciences*. 57:M455-M459, 2002.
36. Kyle, U. G., Genton, L., Gremion, G., Slosman, D.O., Pichard, C. Aging, physical activity and height-normalized body composition parameters. *Clinical nutrition*. 23:79-88, 2004.
37. LaStayo, P., Ewy, G., Pierotti, D., Johns, R., Lindstedt, S. The positive effects of negative work: Increased muscle strength and decreased fall risk in a frail elderly population. *The journals of gerontology. Series A, Biological sciences and medical sciences*. 58:M419-M424, 2003.
38. Lemmer, J. T., Hurlbut, D.E., Martel, G.F., Tracy, B.L., Ivey, F.M., Metter, E.J., Fozard, J.L., Fleg, J.L., Hurley, B.F. Age and gender responses to strength training and detraining. *Medicine and science in sports and exercise* 32:1505-1512, 2000.
39. Lemmer, J. T., Ivey, F.M., Ryan, A.S., Martel, G.F., Hurlbut, D.E., Metter, J.E., Fozard, J.L., Fleg, J.L., Hurley, B.F. Effect of strength training on resting metabolic rate and physical activity: age and gender comparisons. *Medicine and science in sports and exercise* 33:532-541, 2001.
40. Leppaemaeki, S., Partonen, T., Hurme, J., Haukka, J.,Loennqvist, J. Randomized trial of the efficacy of bright-light exposure and aerobic exercise on depressive symptoms and serum lipids. *Journal of Clinical Psychiatry*. 63:316-321, 2002.

41. Lord, S., Murray, S., Chapman, K., Munro, B., Tiedemann, A. Sit-to-stand performance depends on sensation, speed, balance, and psychological status in addition to strength in older people. *The journals of gerontology. Series A, Biological sciences and medical sciences*. 57:M539-M543, 2002.
42. McAuley, E., Jerome, G.J., Elavsky, S., Marquez, D.X., Ramsey, S.N. Predicting long-term maintenance of physical activity in older adults. *Preventive medicine*. 37:110-118, 2003.
43. McLester, J. R., Bishop, P.A., Smith, J., Wyers, L., Dale, B., Kozusko, J., Richardson, M., Nevett, M.E., Lomax, R. A series of studies--a practical protocol for testing muscular endurance recovery. *Journal of strength and conditioning research*. 17:259-273, 2003.
44. Metter, J., Talbot, L., Schrager, M., Conwit, R. Skeletal muscle strength as a predictor of all-cause mortality in healthy men. *The journals of gerontology. Series A, Biological sciences and medical sciences*. 57:B359-B365, 2002.
45. Morley, J. Sarcopenia Revisited. *J Gerontol A Biol Sci Med Sci*. 58A:909-910, 2003.
46. Nagi, S. Z. Disability concepts revisited: Implication for prevention. In: *Disability in America: Toward a National Agenda for Prevention*. AM Pope and AR Tarlov (Ed.) Washington DC: National Academy Press, 1991, pp. 309-327.
47. National Center for Health Statistics. Prevalence of overweight and obesity among adults: United States, 1999-2002 Available at: http://www.cdc.gov/nchs/products/pubs/pubd/hestats/obese/obse99.htm Accessed 3/8/05, 2002.
48. Newman, A., Haggerty, C., Kritchevsky, S., Nevitt, M., Simonsick, E. Walking performance and cardiovascular response: Associations with age and morbidity – The Health, Aging and Body Composition Study. *The journals of gerontology. Series A, Biological sciences and medical sciences*. 58:M715-M720, 2003.
49. Pavot, W., Diener, E. Review of the satisfaction with life scale. *Psychological - Assessment*. 5:164-172, 1993.

50. Pennix, B., Rejeski, J., Pandya, J., Miller, M., Di Bari, M.,& Applegate, W. Exercise and depressive symptoms: A comparison of aerobic and resistance exercise effects on emotional and physical function in older persons with high and low depressive symptomatology. *Journals of Gerontology: Series B: Psychological Sciences and Social Sciences*. 57b:124-132, 2002.
51. Phillips, W. T., Batterham, A.M., Valenzuela, J.E., Burkett, L.N. Reliability of maximal strength testing in older adults. *Archives of physical medicine and rehabilitation* 85:329-334, 2004.
52. Rejeski, W., Mihalko, S. Physical activity and quality of life in older adults. *J Gerontol A Biol Sci Med Sci*. 56:23-35, 2001.
53. Rhea, M., Alvar, B., Burkett, L., et al. A meta-analysis to determine the dose response for strength development. *Medicine and science in sports and exercise*:456-464, 2003.
54. Riebe, D., Burbank, D., & Garber, C. Promoting exercise and behavior change in older adults: Interventions with the transtheoretical mode. In: *Setting the stage for active older adults*. D. R. P.Burbank (Ed.) New York, NY: Springer, 2002, pp. 1-28.
55. Rikli, R. E., Jones, C. The reliability and validity of a 6-minute walk test as a measure of physical endurance in older adults. *Journal of aging and physical activity*. 6, 1998.
56. Rikli, R. E., Jones, C.J. Assessing physical performance in independent older adults: Issues and guidelines. *Journal of aging and physical activity*. 5:247, 1997.
57. Rikli, R. E., Jones, C.J. Development and validation of a functional fitness test for community-residing older adults. *Journal of aging and physical activity*. 7:129-161, 1999.
58. Rikli, R. E., Jones, C.J. Functional fitness normative scores for community - residing older adults, ages 60-94. *Journal of aging and physical activity*. 7:162-181, 1999.
59. Rose, D., Jones, C., Lucchese, N. Predicting the probability of falls in community - residing older adults using the 8' up-and-go: A new measure of functional mobility. *Journal of aging and physical activity*. 10:466-475, 2002.

60. Rosenberg, I. H. Epidemiologic and methodologic problems in determining nutritional status of older persons. *American journal of Clinical Nutrition*:1231-1233, 1989.
61. Roth, S., Martel, G., Ivey, F., Lemmer, J., Tracy, B., Metter, E., Hurley, B., Rogers, M. Skeletal Muscle satellite cell characteristics in young and older men and women after heavy resistance strength training. *J Gerontol A Biol Sci Med Sci*. 56:B240-247, 2001.
62. Roth, S. M., Ivey, F.M., Martel, G.F., Lemmer, J.T., Hurlbut, D.E., Siegel, E.L., Metter, E.J., Fleg, J.L., Fozard, J.L., Kostek, M.C., Wernick, D.M., Hurley, B.F. Muscle size responses to strength training in young and older men and women. *Journal of the American Geriatrics Society* 49:1428-1433, 2000.
63. Roubenoff, R., Hughes, V. Sarcopenia: Current concepts. *J Gerontol A Biol Sci Med Sci*. 55:M716-724, 2000.
64. Rubenstein, L., Josephson, K., Trueblood, P., Loy, S., Harker, J., Pietruszka, F., Robbins, A. Effects of a group exercise program on strength, mobility, and falls among fall-prone elderly men. *J Gerontol A Biol Sci Med Sci*. 55:M317-321, 2000.
65. Sale, D. Neural Adaptation to resistance training. *Medicine and science in sports and exercise*. 20:S135-145, 1988.
66. Singh, N., Clements, K., Singh-Fiatarone, M. The Efficacy of exercise as a long-term antidepressant in elderly subjects: A randomized, controlled trial. *J Gerontol A Biol Sci Med Sci*. 56:M497-504, 2001.
67. Staron, R., Karapondo, D., Kraemer, W., Fry, A., Gordon, S., Falkel, J., Hagerman, F., Kikida, R. Skeletal muscle adaptations during early phase of heavy-resistance training in men and women. *Journal of applied physiology*. 76:1247-1255, 1994.
68. Stewart, A., Verboncoeur, C., McLellan, B., Gillis, D., Rush, S., Mills, K., King, A., Ritter, P., Brown, B., Bortz, W. Physical activity outcomes of CHAMPS II: A physical activity promotion program for older adults. *J Gerontol A Biol Sci Med Sci*. 56:M465-470, 2001.
69. Sward, K. L. Effect of resistance training on muscular Strength, functional fitness, physical self-perception, and quality of life in the elderly. *Dissertation Abstracts International: Section B: The Sciences & Engineering*. 62:3967, 2002.

70. Trappe, S., Williamson, D., Godard, M. Maintenance of whole muscle strength and size following resistance training in older men. *The journals of gerontology. Series A, Biological sciences and medical sciences.* 57:B138-B143, 2002.
71. U. S. Department of Health and Human Services Center for Disease Control and Prevention. Healthy Aging for Older Adults. Available at: www.cdc.gov/aging/ Accessed 9/6/2005, 2005.
72. U.S. Department of Health and Human Services. Healthy People 2010: Washington DC: US Government Printing Office, 1998.
73. Volpi, E., Nazemi, R., Fujita, S. Muscle tissue changes with aging. *Current opinion in clinical nutrition and metabolic care.* 7:405-410, 2004.
74. Ware, J., Kosinski, M., Turner-Bowker, D., & Gandek, B. *How to score version 2 of the SF-12® Health Survey.* Lincoln, RI: Quality Metric Incorporated, 2002

APPENDICES

Appendix A

Informed Consent

Informed Consent

Title of Study: Strength training in a community dwelling elderly population, follow-up of a two year peer led strength training program

Investigator: Richard J Burke

Address: The University of Tennessee
Department of Health and Exercise Science
303 HPER Building
1914 Andy Holt Avenue
Knoxville, TN 37966

Telephone: 865-974-3340

Faculty Advisor: Dr. David Bassett

PURPOSE

The purpose of this research study is to examine if a peer-led combined aerobic & weight training program has benefited the senior population.

Procedures

These tests will be exactly as the previous tests conducted over the past two years. You will complete a 6-minute walk (aerobic endurance), number of bicep curls in 30 seconds (bicep strength and endurance), number of chair stands in 30 seconds (leg strength and endurance), 8' up and go (balance and coordination), sit and reach (lower body flexibility), back scratch (upper body flexibility), and the SF-12 Quality of Life Survey. Your entire participation time will be less than 4hrs total.

You are invited to be in the study because for the past two years you gone three times a week at 10:00am for one hour, to the Nutrition center in Cedartown and have participated in strength training (hand weights or dumb bells) exercises. These included bicep curls, triceps extensions, shoulder raises, Rhomboid raises, (hand pulled back to pocket from an outstretched position) leg raises,

wrist curls, chair stands, and 6-minute walks. Stretching exercises included toe touches and back scratches.

Risks and Benefits

The discomforts or stresses you may face during this research are: muscle strains, muscle/soreness, pain/soreness, fatigue, muscle hematoma, bruising of the skin, pressure on the joints, rupture of tendons or muscles, joint effusions, increased blood pressure, heart attack, faintness, dizziness, and /or mild discomforts associated with the exercise and/or testing protocol.

However the activity has been and will be of moderate intensity and the extent of over-exertion is expected to be comparable to that which you have already become used to during the initial study.

Confidentiality

The results of this participation will be confidential and will not be released in any individually identifiable form without your prior consent.

Right to Ask Questions and to Withdraw

You are free to decide whether or not to participate in this study and are free to withdraw at any time. Before you sign this consent form, please ask any questions that you may have with regard to this study.

Emergency Medical Treatment

The University of Tennessee does not "automatically" reimburse subjects for medical claims or other compensation. If physical injury is suffered in the course of research, or for more information, please notify the investigator in charge Richard J Burke, 865-974-3340.

Contact information

If you have questions at any time about the study or the procedures, (or you experience adverse effects as a result of participating in this study,) you may contact the

researcher, Richard J Burke , at 1914 Andy Holt Avenue, 303 HPER building, University of Tennessee, Knoxville, TN 37996., Phone, HPER Office (865) 974-3340. If you have questions about your rights as a participant, contact Research Compliance Services of the Office of Research at (865) 974-3466.

Consent

I, agree to participate in the research entitled "A longitudinal study of the Physiological benefits of aerobic exercise and strength training for seniors", which is being conducted by Richard J Burke, Graduate Student, University of Tennessee Knoxville. I understand that this participation is entirely voluntary; I can withdraw my consent at any time and have the results of the participation returned to me, removed from the experimental records, or destroyed.

_____ _____

Signature of Participant Date:

_____ _____

Signature of Investigator Date:

Appendix B

Health History Questionnaire

HEALTH HISTORY INFORMATION

NAME:_____

DATE OF BIRTH:_____

SEX: MALE FEMALE WEIGHT:_____ AGE:_____

HEIGHT _____

HAVE YOU EVER EXPERIENCED ANY OF THE FOLLOWING? (place an X next to ALL that apply)

HEART DISEASE	_____	HEART PALPITATIONS	_____
HIGH BLOOD PRESSURE	_____	HIGH CHOLESTEROL	_____
ASTHMA	_____	SHORTNESS OF BREATH	_____
DIABETES	_____	JOINT INJURIES	_____
BACK INJURIES	_____	ARTHRITIS	_____
HERNIA	_____	EPILEPSY	_____
ALLERGIES	_____	FATIGUE OR DIZZINESS	_____

ARE YOU ALLERGIC TO ANY MEDICATIONS? NO_____ YES_____
EXPLAIN IF YES

_____

ARE YOU CURRENTLY TAKING ANY MEDICATIONS? NO_____ YES _____- LIST IF YES

_____

ON THE AVERAGE PER WEEK:

HOW MUCH CAFFINE DO YOU CONSUME?_____ ALCOHOL?_____

HOW WOULD YOU RATE YOUR TENSION LEVEL? LOW MODERATE HIGH (circle one)

DESCIBE YOUR ACTIVITY LEVEL: (place an X in only one box)

SEDENTARY (no exercise or activity) _____

MODERATELY ACTIVE (1-2X/week for 20 minutes) _____

ACTIVE (3X/week for 30 minutes) _____

EXTREMELY ACTIVE (4+X/week for 30 minutes or more) _____

FAMILY HISTORY (INCLUDING PARENTS, GRANDPARENTS, AND SIBLINGS)

Condition	Who (relation)	Age (of onset)	Living (yes or no)
Heart Attack			
CV Disease			
High Blood Pressure			
High Chol/Trig			
Diabetes			

Briefly explain the type of work that you do (did):

_____

_____

_____

Do you climb stairs on a regular basis (circle one) yes no

Approximately how much have you walked (per week) in the last month? (check one)

___ 0-1 mile per week

___ 1-2 miles per week

___ 2-4 miles per week

___ over 4 miles per week

When was the last time (if ever) you engaged in weight training (resistance training)? Please explain.

_____

_____

_____

Thank you for participating!

Appendix C

Tables

Pre-test (March 2002) post-test (1) (May 2002), post-test (2) (June 2003), and post-test (3) (June 2005) actual scores: Normative percentile scores from Rikli & Jones Senior Fitness Test Manual[58].

Table 2: 6-minute-walk in meters walked

Subject	Pre Test 2002	Normative Percentile	Post Test 2002	Normative Percentile	Post Test 2003	Normative Percentile	Post Test 2005	Normative Percentile
1	96.62	11	150.87	61	150.52	71	121.92	30
2	119.48	14	184.4	75	238.65	> 90	131.97	23
3	60.96	11	60.96	11	30.48	< 10	50.9	< 10
4	119.48	40	61.87	< 10	46.51	< 10	71.01	< 10
5	50.9	< 10	44.8	< 10	30.48	< 10	111.86	21
6	191.1	85	246.88	> 90	238.65	> 90	233.47	> 90
7	134.72	16	180.13	66	202.99	88	101.49	< 10
8	119.48	16	75.89	< 10	131.97	25	81.38	< 10
9	139.59	20	182.88	73	198.12	84	167.64	50
MEAN	114.7		132.06		142.05		119.05	

Grayed cells contain data using EM function is SPSS-11

Table 3: Number of arm-curls in 30 seconds

Subject	Pre Test 2002	Normative Percentile	Post Test 2002	Normative Percentile	Post Test 2003	Normative Percentile	Post Test 2005	Normative Percentile
1	9	18	15	67	22	>90	22	>90
2	12	20	18	67	23	>90	22	>90
3	6	10	12	63	16	90	12	63
4	7	10	18	> 90	20	>90	19	>90
5	10	25	19	> 90	19	>90	22	>90
6	20	90	19	85	23	>90	25	>90
7	12	25	18	80	20	20	30	>90
8	9	15	25	> 90	30	>90	24	>90
9	13	34	24	> 90	26	>90	24	>90
MEAN	10.89		18.67		22.11		22.22	

Grayed cells contain data using EM function is SPSS-11

Table 4: Number of chair-stands in 30 seconds

Subject	Pre Test 2002	Normative Percentile	Post Test 2002	Normative Percentile	Post Test 2003	Normative Percentile	Post Test 2005	Normative Percentile
1	11	50	10	38	12	58	13	67
2	10	25	15	75	14	66	13	58
3	6	37	10	66	10	66	3	17
4	2	< 10	2	< 10	11	37	2	< 10
5	9	25	9	25	10	37	13	67
6	10	25	12	50	14	66	15	75
7	12	37	9	17	10	25	10	25
8	4	< 10	5	< 10	10	25	8	10
9	9	17	12	42	12	42	12	42
MEAN	8.11		9.33		11.44		9.89	

Grayed cells contain data using EM function is SPSS-11

Table 5: 8 foot up-and-go. Rise from a seated position, walk around a cone and return to seated position

Subject	Pre Test 2002	Normative Percentile	Post Test 2002	Normative Percentile	Post Test 2003	Normative Percentile	Post Test 2005	Normative Percentile
1	8.56	28	6.19	63	6.26	62	6.34	61
2	9.4	< 10	6.13	55	5.6	67	6.19	55
3	17.62	< 10	17.62	< 10	9.44	50	12.3	15
4	20.15	< 10	10.03	11	11.19	< 10	18	< 10
5	8.89	25	7.72	43	11.47	< 10	13.6	< 10
6	6.2	44	4.87	68	4.16	> 90	5	67
7	8.94	< 10	7.73	15	7.5	20	7.47	20
8	8.57	< 10	11.22	< 10	7.12	18	7.5	30
9	7.49	< 10	5.15	70	5.5	62	5.72	58
MEAN	10.65		8.52		7.58		9.12	

Table 6: Sit-and-reach to toes in inches. (+) = over-lap (-) = under-lap between fingertips and toes

Subject	Pre Test 2002	Normative Percentile	Post Test 2002	Normative Percentile	Post Test 2003	Normative Percentile	Post Test 2005	Normative Percentile
1	0	45	0	45	0	45	1	55
2	0	65	2	80	2.5	85	0.5	60
3	0	65	0	65	0.5	70	0	65
4	-3	20	0	62	0	62	0	62
5	-4	< 10	0.5	50	0.5	50	0	45
6	2	60	2	60	3	70	2	60
7	0	30	0.5	35	0	30	0	30
8	0	40	0	40	1	50	1	50
9	1	35	1	35	0.5	30	0	30
MEAN	-0.44		0.67		0.89		0.50	

Table 7: Back Scratch in inches between fingers. (+) = over-lap (-) = under-lap of fingers

Subject	Pre Test 2002	Normative Percentile	Post Test 2002	Normative Percentile	Post Test 2003	Normative Percentile	Post Test 2005	Normative Percentile
1	- 15	< 10	- 9	< 10	0	75	- 5	30
2	- 7	40	- 5	55	- 5	55	- 5	55
3	0	85	0	85	1	90	0	85
4	- 13.5	< 10	- 4	50	0	85	- 10	10
5	- 14	< 10	- 2.5	50	- 1	65	- 15	< 10
6	0.5	75	2.5	85	2.5	85	2.5	85
7	- 5	20	- 2.5	40	- 0.5	70	1	75
8	- 5	25	- 3	40	- 3	40	- 3	40
9	0	65	0	65	2	80	0.5	70
MEAN	-6.56		-2.61		-0.44		-3.78	

Table 8: Repeated measures ANOVA

Test	Significance
6-minute walk	0.713
Arm Curl in 30 seconds	0.000*
8 foot up-and-go	0.254
Number of chair stands in 30 seconds	0.144
Sit-and-reach in inches	0.270
Back-scratch in inches	0.089

Table 9: Tukey Post Hoc Test- Arm Curls

Post Hoc Test Arm Curls	
CURL - PRE - POST - 1	0.007*
CURL - PRE - POST - 2	0.001*
CURL - PRE - POST - 3	0.000*
POST - 1 - POST - 2	0.009*
POST - 1 - POST - 3	0.212
POST - 2 - POST - 3	1.000

Adjustment for multiple comparisons: Bonferroni.

VITA

Richard Burke attended Kennesaw State University in Kennesaw GA. and received his Bachelor of Science degree in Exercise Science in 2002. He continued at Kennesaw receiving a Graduate Certificate in Gerontology in 2003. He was a Graduate research Assistant, and a Graduate Teaching Assistant during the 2002-2003 school years. Richard entered the graduate program in Exercise Science at the University of Tennessee, Knoxville in August 2003. While at the University of Tennessee he assisted in a Gerontology peer leadership pilot study. In December of 2005 he received a Master of Science degree with an emphasis in Exercise Physiology.

7695 2036 60
03/08/06 MAR