Effect of a Community-Based Strength and Flexibility Program on Performance-Based Measures of Physical Fitness in Older African-American Adults

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Abstract

With the rapid growth of the number of Americans aged 65 or older resulting in expectations of doubling the number of the population in that age bracket, health professionals and fitness experts will be called upon to develop and implement methods for keeping this population as healthy as possible for as long as possible, and to aid these individuals with retaining their quality of life. This study examined whether incorporating a low-cost, community-based strength and flexibility program would improve performance-based measures of strength, flexibility, and endurance in older (57 to 82 yr.; M = 68 yr., SD = 5 yr.) African-American adults. Evaluated components were upper body strength (maximal amount of weighted arm curls), lower body strength (maximal amount of chair-ups), upper body flexibility (back-scratch), lower body flexibility (modified sit-and-reach), and aerobic endurance (maximal distance covered in 6 minutes). Twenty African-American adults (5 male and 15 female) volunteered to participate in five weeks of strength and flexibility training (twice per week, 60 min. per session). Posttest results showed performance improvements for all five measured parameters, with significant improvements found for upper- and lower- body strength and lower body flexibility. Additionally, the structure of this exercise program resulted in adherence rates of more than 80%. In light of these findings, it is important that the design of strength and flexibility programs for older adults be implemented through the collaboration of health professionals and fitness experts; it is with this multifaceted approach to aging that an improvement in quality of life in later years can be achieved successfully.

Keywords: Older Adults, Elderly, African-American, Strength Training, Functional Fitness, Community Program

Introduction

Currently there are more than 33 million Americans age 65 years or greater living in the United States; a number that will more than double over the next century, with the majority of the increase occurring with individuals over the age of 85 years (U.S. Department of Health and Human Services, 2000). This rapid growth of the elderly population provides a unique opportunity for health care providers to develop and deliver prescriptions for healthy living. One such strategy for promoting health and independent living for the elderly population is strength training.

Strength training has been shown to promote overall health and independent living in older adults (National Institute on Aging, 2001). Importantly, strength training has been recommended to decrease the risk of falls and fractures related to the aging process (Christmas & Andersen, 2000). Age-related declines in muscular strength, muscular endurance, flexibility, bone density, and balance highly correlate with an increase in the prevalence of falls, osteoporotic fractures, and a general inability for independent living in the elderly. Approximately 30% of community-dwelling older adults in developed countries fall at least once each year, with just under 5% of these falls leading to bone fractures (Gregg, Pereira, & Caspersen, 2000). Moreover, the one-year post-fracture mortality rate is as high as 40%, with the associated annual healthcare costs estimated

as high as 10 billion dollars (Wolinsky, Fitzgerald & Stump, 1997). Possible mechanism by which strength training may prevent the incidence of falls and subsequent bone fractures include increases in muscular strength (Adams, Swank & Berning, 2001; Chandler, Duncan, Kochersberger & Studenski, 1998), muscular endurance (McCartney, Hicks, Martin & Webber, 1995), flexibility (Barbosa, Santarem, Filho & Marucci, 2002), bone mineral density (Kohrt, Ehsani & Birge, 1997), and balance (Messier, Royer, Craven, O'Toole, Burns & Ettinger, 2000).

The positive effects of strength training has led the American College of Sports Medicine to recommend that adults include strength training as part of a comprehensive physical fitness program (American College of Sports Medicine, 1998). Moreover, the U.S Department of Health and Human Services (2000) has set as a national health objective in Healthy People 2010 the goal of increasing to 30% the number of adults who perform at least 2 days a week of physical activity that leads to the enhancement or maintenance of muscular strength and endurance. Currently, only 11% of persons aged > 65 meet this strength training objective (U.S. Department of Health and Human Services, 2003). Consequently, there is a need for health care providers to promote strength training as a "real" prescription for health and longevity.

Presently, one of the key challenges public health providers face relating to strength training programs is providing safe and effective implementation of these programs to the communities in which the elderly live (Seguin & Nelson, 2003). It is important to appreciate the many factors (e.g., transportation, fixed incomes, confidence, and lack of independence) that may limit elderly community dwellers access to "state of the art" fitness facilities, thereby limiting their access to strength training regimes. For these reasons it is important to develop strength training programs and implementation strategies that will facilitate elderly participation. One way to address this challenge is to incorporate low-cost strength training programs within the community centers frequented by the elderly.

Therefore the purpose of the present study was to develop and implement a successful, low-cost, community-based strength and flexibility program for older African-American adults. Specifically, it was hypothesized that the successful implementation of a community-based strength and flexibility program would improve performance based measures of strength, flexibility, agility and endurance.

Methods

Subjects

Twenty African-American older adults (five men and 15 women) were recruited from a local community center to participate in a five-week (10-session) muscular strength and flexibility training program. All participants lived independently, and were not considered frail. Their ages ranged from 57 to 82 years (M = 68, SD = 5) (see Table 1 for sample characteristics) and all participants were members of a group exercise program held at the community center. Prior to the beginning of the program, all participants signed an informed consent and were required to provide a medical consent signed by their primary care physician. This study was part of a larger study evaluating the effect of strength training on the associations between self-reported and performance-based measures of physical fitness.

Strength and Flexibility Training Program

The main objective for developing the strength and flexibility training program was to create a low-cost program that could be incorporated within the participants' usual exercise regimen that included group exercise sessions at the community center. These exercise sessions met twice a week and included low impact aerobics and stretching exercises performed while seated in a chair. Therefore, it was important for the strength and conditioning program to be structured within the confines of the pre-existing exercise program. For this reason, a five-week training program was developed that included two sessions a week. Each session was 60 minutes long, and was performed at the local community center from which participants were recruited.

Table 1
Sample Characteristics

Measure	Men (n=5)		Women (n=15)		All (n=20)	
	Mean	SD	Mean	SD	Mean	SD
Age, yr.	67.2	2.5	68.1	6.2	67.9	5.4
Height (meters)	1.8	*	1.7	*	1.7	*
Weight (kg.)	109.4	9.2	87.2	12.6	92.7	15.5
Resting Systolic BP (mmHg)	150.0	21.7	134.7	17.6	138.6	19.3
Resting Diastolic BP (mmHg)	85.0	11.6	80.9	8.2	81.9	9.0
RHR (bpm)	69.8	14.7	72.8	9.1	72.8	10.5
BMI (kg/m^2)	33.8	1.9	31.5	4.6	32.1	4.2

* skewed distribution with large standard deviations

Due to the limited availability of strength training machines, the program utilized dumbbells, resistance bands, and resistance balls. The equipment was purchased for under $300.00 and was donated to the community center following the completion of the research study. During each training session, participants completed one to two sets of between 8 to 12 repetitions of a total of 20 exercises working all major muscle groups. Specifically, there were nine exercises concentrating on the major muscle groups of the upper body (i.e., chess press, lat pull downs, wall push-ups, two types of arm curls, shoulder front raises, shoulder press, triceps kickback (extensions), and modified dips), seven exercises concentrating on the major muscle groups of the lower body (i.e., leg extension, hip flexion, ball squats, hip extension, straight leg deadlifts, reverse leg curls and calf raises), two exercises concentrating on the major muscle groups of the core (i.e., ab machine and side bends), and two exercises concentrating on aerobic endurance (i.e., walking on the treadmill and riding a stationary bike).

Each training session started and ended with 10 minutes of stretching. Each participant was assigned a student trainer to ensure safety and proper execution of exercises. The student trainer also adapted the intensity of the strength training program as needed, thereby continuing to provide physiological adaptations to the muscle groups worked. Functional assessments (Senior Fitness Test) were administered on the first day and on the last day of the program. Due to the personal attention provided by the student trainers, adherence rates were extremely high (>80%).

Assessment of Performance-Based Measures of Physical Fitness

Performance-based measures of physical fitness were estimated using selected items of the Senior Fitness Test developed by Rikli and Jones (1999a). The test items selected were upper body strength, lower body strength, upper body flexibility, lower body flexibility, and aerobic endurance. All tests (pre- and post-tests) were conducted by the same group of individuals specifically trained in administering the Senior Fitness Test. For each test, recommended protocols were followed; no modifications were necessary.

Briefly, the number of arm-curls completed while seated in a chair (five-pound weights for women and eight-pound weights for men) was used to estimate upper body strength; lower body strength was estimated based on the number of chair stands completed in thirty seconds. The test started with participants seated in the middle of the chair with their arms crossed against their chest. Participants were instructed to complete as many full stands as possible. A "back-scratch" test was used to estimate upper body flexibility and a modified sit-and-reach test was used to measure lower body strength. For the back-scratch test, participants stood, placing the preferred hand behind the same-side shoulder. The other hand was then placed behind the back, attempting to touch or overlap the

extended middle fingers of both hands. The distance between the fingers (minus score) or overlap (positive score) was indicative of upper body flexibility. For the modified sit-and-reach test, participants started in a seated position on a chair, with one leg bent and one leg extended. They were then asked to bend forward (at the hip joint) sliding their hands down the extended leg, attempting to touch the toes. The distance between the hands and the toes (minus score) or the number of inches they reached beyond the toes (positive score) estimated lower body flexibility. Aerobic endurance was estimated by recording the maximum distance covered in 6 minutes, walking along a 40-yd course marked in five-yd segments. Space limitations required a slight modification from the Rikli and Jones test which uses a 50-yd course. Body composition was estimated by recording participants' height and weight and calculating their body mass index (BMI = kg/m2). For the complete description of all tests utilized within the performance-based physical fitness assessment protocol, refer to Rikli & Jones (1999a).

Test-retest reliability for each test item (Rikli & Jones, 1999a) was established by calculating intraclass correlation coefficients (R) using a one-way ANOVA model. Intraclass reliability values ranged from 0.80 to 0.98, with the majority of the values being 0.90 or above, indicating high test-retest reliability. Criterion validity was estimated by calculating intraclass correlation coefficients (Pearsons's r) between test items and established performance norms for all test items except the back-scratch (no single criterion measures are available for this test). The following criterion measures were used: 30-second chair stand – 1-RM (i.e., repetition maximum) leg press; arm curls – combined 1-RM chest press, biceps, and upper back; two-minute step test – one-mile walk time; chair sit-and-reach-test – goniometer measured hamstring flexibility. The correlations ranged from 0.71 (moderately high) to 0.86 (high), supporting the criterion validity of the tests. Furthermore, the authors developed population norms based on a sample of approximately 7000 older adults (Rikli & Jones, 1999b) recruited from 20 different sites within the Los Angeles area. Similar to our study sample, participants were community- residing, functionally independent older adults, ranging in age from 60 to 94 years.

Results

In order to test the hypothesis, paired sample t-tests were used to investigate differences between pre- and post- performance-based measures. For all analyses, p values of < 0.05 were used. A description of the participants is provided in Table 1. The majority (n = 19) of scores for men and women fell within the normal range (25-75th percentile) for each of the performance-based measures of physical fitness based on the standards provided by Rikli and Jones (1999b); only one participant scored below the normal range (<25th percentile) on all measures.

Both performance-based measures for strength, Chair Stands ($t = -4.4$, $p = 0.001$) and Arm Curls ($t = -4.8$, $p = 0.001$), and one performance-based measure for flexibility, Sit-and-Reach ($t = -3.3$, $p = 0.004$), were significantly improved following the 5-week strength and conditioning program (Table 2). All other performance-based measures of physical fitness were not significantly ($p > .05$) different following the 5-week strength and conditioning program.

Discussion

The present study evaluated the effectiveness of developing and implementing a successful, low-cost, community-based strength and flexibility program for older African-American adults; with the impetus being to facilitate the participation of elderly adults. The five-week strength and flexibility program was conducted in a local community center frequented by older adults. Furthermore, care was taken to schedule the program within the constraints of an already existing exercise program to ensure minimal disruption of established routines and to promote maximal participation. With adherence rates greater than 80%, this strategy proved successful.

Table 2
Means (*M*) and Standard Deviations (*SD*) for Performance and Self-Reported Pre- and Post-Measures

Measure	Men (n=5)		Women (n=15)		All (n=20)	
	Mean	SD	Mean	SD	Mean	SD
Pre-Measures:						
Performance Measures*						
Chair Stands	9.6	5.5	11.2	4.7	10.8	4.8**
Arm Curls	20.0	4.4	19.0	2.9	19.3	3.2**
6-Minute Walk	535.0	147.2	488.6	130.3	500.7	132.4
Sit-and-Reach	-3.0	4.6	0.8	3.2	-0.1	3.9**
Back Scratch	-7.7	5.6	-3.2	5.7	-4.3	5.9
Post-Measures:						
Performance Measures*						
Chair Stands	15.0	1.7	15.0	5.4	15.0	4.6
Arm Curls	23.8	6.3	21.3	3.8	22.5	4.6
6-Minute Walk	577.0	117.4	521.9	89.0	537.2	97.4
Sit-and-Reach	-1.2	5.9	1.7	3.3	0.9	4.2
Back Scratch	-6.3	5.7	-2.7	5.9	-3.7	5.9

**= significant difference at $p < .05$ between pre- and post-measures for the group as a whole ($n = 20$). * Chair Stands=number completed in 30 sec.; Arm Curls=number completed in 30 sec.; 6-Minute Walk=distance (yd.) covered in 6 min.; Sit-and-Reach=inches between fingertips and toes; Back Scratch=inches between fingertips.

It was hypothesized that five weeks of strength and flexibility training would significantly increase performance-based measures of strength, flexibility, and endurance. The findings from the present study support this hypothesis. Five weeks of strength and flexibility training improved all performance-based measures of physical fitness. Significant increases were found for both performance-based measures for strength (chair stand and arm curls), and one performance-based measure for flexibility (sit-and-reach); increases in performance, though statistically insignificant, were found for endurance and upper body flexibility.

These findings provide evidence that significant strength and flexibility changes are possible after only five weeks of strength and flexibility training. Furthermore, these strength changes could make a significant impact on older adults' activities of daily living (ADLs). Fiatarone, Marks, Ryan, Meredith, Lipsitz and Evans (1990) concluded that a combination of increased muscle strength and mass, and walking speed, may reduce physiological and functional impairments, as well as decrease the risk for falls. The 39% lower body strength improvement, coupled with the 17% upper body strength improvement, reported within the current study could significantly impact older adults' functional independence and mobility. This improved functional independence could promote additional physical activity not thought possible before the intervention. Examples of ways in which performance of ADLs could improve are that participants may feel more comfortable taking the stairs instead of using the elevator, walking instead of riding in a motorized cart, or simply performing activities like gardening and/or cleaning; all which provide a functional form of physical exercise.

This is an exciting time in our history. Advances in science and medicine, better quality nutrition, and increased amounts of resources, all contribute to Americans living longer today than they did as recent as 50 years ago (Allsen, Harrison, and Vance,1996). However, increased longevity does not necessarily guarantee a high quality of life in these extended years. Therefore, we have a responsibility as health care and fitness providers to work together to develop multifaceted approaches to successful

aging. These approaches may include social, psychological and physical aspects of successful aging. Moreover, it is crucial for the success of any program to "go to" where the older adults frequent, and to adapt to their schedules and their needs. It is only through this approach that we are going to increase the percent of older adults participating in strength training activities to obtain the Healthy People 2010 objective of 30%.

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