Journal of Extension
www.joe.org

August 2015
Volume 53
Number 4
Article # 4RIB2
Research In Brief

StrongWomen® Program Evaluation: Effect of Strength Training Exercises on Physical Fitness of Participants

Abstract

The StrongWomen® Program (SWP) is a nationally disseminated group strength-training exercise and nutrition education program delivered by Extension. The study reported here examined the effect of strength training exercises in SWP on improvement in physical fitness of program participants. Senior Fitness Test was used to collect data. Upon analysis of paired *t*-tests, significant differences were found between pre-test and post-test across all the six fitness measures. Overall, SWP helped participants to improve their body strength and physical fitness and decreased risk of falls and fractures, which indicates the increased independence and quality of life among older adults.

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Introduction

Aging is commonly associated with decline in physiological and functional ability of adults, which in turn can cause them to be susceptible to falls, fractures, and chronic diseases such as osteoporosis, arthritis, and type 2 diabetes (Ball et al., 2013; Nelson et al., 1994; Seguin, Heidkamp-Young, Kuder, & Nelson, 2012; Seguin & Nelson, 2003). The main reason for decline in physiological and functional ability of adults is sarcopenia, the reduction in muscle mass and body strength with increase in age (Ball et al., 2013; Seguin & Nelson, 2003). Sarcopenia is regarded as a major factor causing reduced quality of life, decreased independence, and increased occurrence of chronic diseases and mortality in older adults (Ball et al., 2013; Moreland, Richardson, Goldsmith, & Clase, 2004; Seguin & Nelson, 2003).

Strength-training exercises are have proven to be the most effective prevention measure to address sccropenia (Ball et al., 2013; Elsangedy et al., 2013; Nelson et al., 1994; Seguin & Nelson, 2003). Strength-training exercises are defined as any kind of physical activity that attenuates muscle loss and improve muscle strength and mass (Ball et al., 2013; Nied & Franklin, 2002; Spencer et al., 2012). Strength-training exercises have been shown to improve muscle mass and increase bone

mineral density and body strength, while reducing chronic diseases (osteoporosis, arthritis, and type 2 diabetes), fractures, and mortality among older adults (Ball et al., 2013; Elsangedy et al., 2013; Kang & Russ, 2009; Nelson et al., 1994; Rosario, Villani, Harris, & Klein, 2003; Seguin et al., 2012; Seguin & Nelson, 2003; Seguin et al., 2010, Spencer et al., 2012).

In spite of the proven researched effects of strength-training exercises and recommendations by experts such as the American College of Sports Medicine to engage in strength training exercises at least twice a week, a large percentage of adults in the U.S. (46%) do not get sufficient physical activity, and 29% are categorized as sedentary (Elsangedy et al., 2013; Klein, Burr, & Stone, 2005; Seguin et al., 2008). Common barriers to exercise in older adults are poor self-efficacy, fear of injury, personal habits, negative attitude, poor balance, economic affordability, illness, and accessibility of exercise facilities (Nied & Franklin, 2002; Seguin et al., 2008). Community-based strength-training exercise programs have proved to be an efficient answer to these barriers (Klotzbach-Shimomura, 2001; Sallis et al., 2006; Sedlak, Doheny, & Jones, 2000; Seguin et al., 2008; Seguin et al., 2010; Seguin et al., 2012). Older adults are more motivated to participate in community-based exercise programs compared to fitness clubs because they are more accessible, more affordable, and less intimidating due to social and peer support (Seguin et al., 2008).

Cooperative in land-grant universities offers community-based educational programs using research-based information to address the issues faced by communities in the United States (Mincemoyer, Perkins, & Lillehoj, 2004). The StrongWomen® Program (SWP) is one among various programs offered by Extension. SWP is a nationally disseminated group strength-training exercise and nutrition education program that translates-research-based, strength-training exercise, and nutrition requirements into a detailed and easy-to-follow curriculum that can be used in community settings. The program was mainly designed for midlife and older women, but the program is also open to men (Nelson et al., 1994; Seguin et al., 2008; Seguin et al., 2010).

Purpose and Objectives

The study reported here is part of a larger evaluation of the StrongWomen® program. The specific objective of the study was to examine the effect of strength training exercises in SWP on improvement in physical fitness of the program participants.

Methodology

StrongWomen® Program and Design of the Study

The study used one group pre-post design (Campbell & Stanley, 1963) that tracks changes in program outcomes over a period of time. The convenience sample of participants was used to collect data. The SWP was delivered as a series of 24 classes, meeting twice weekly for 12 weeks, with classes typically lasting 60 – 75 minutes. Trained site leaders guided participants through simple, safe, and effective exercises using free and ankle weights. The site leaders also regularly facilitated discussions focusing on nutrition and health issues, usually based on the university-produced *Creating Health and Nutrition* fact sheets. Community partners who hosted the classes include senior centers, local fire rescue departments, medical centers, community halls, schools, county government buildings, and public

libraries.

Survey Instrument

The data for the study was collected by using the Senior Fitness Test, an instrument developed by Rikli and Jones (2001). The instrument was developed to measure the functional fitness performance relative to muscle strength/endurance; aerobic endurance; flexibility; and motor ability—specifically, power, speed/agility, and balance (Rikli & Jones, 2001). A valid and reliable tool, the instrument was simple and easy to administer and assessed six measures of physical fitness (Table 1) (Rikli & Jones, 2001; Seguin et al., 2012).

Table 1.

Summary of Six Measures of Physical Fitness Used in Senior Fitness Test

Fitness Measure	Purpose	Description
Chair Stand(# in 30 seconds)	Measures lower body strength	Number of full stands that can be completed in 30 seconds with arms folded across chest
Arm Curl (# in 30 seconds)	Measures upper body strength	Number of curls in 30 seconds using a 5 pound weight
2-Minute-Step (# of steps)	Measures the aerobic fitness	Number of high steps completed in a two minute session.
Chair Sit and Reach (nearest 1/2 inch + or -)	Measures lower body flexibility	Distance in inches between extended hand and toes when seated at edge of chair with leg extended: negative number indicates the inability to reach toes
Back Scratch (nearest 1/2 inch + or -)	Measures upper body flexibility	Distance in inches between one hand reaching over shoulder and second hand reaching up the middle of back
8 Foot Up and Go (nearest 1/10 second)	Measures agility/dynamic balance	Number of seconds required to get up from a seated position, walk 8 feet, and return to seated position.

Note: Table adopted from Ball et al., (2013) and Rikli and Jones (2001).

For some measures in the Senior Fitness Test an increase in their values is significant improvement (such as Chair Stand and 2-Minute Step), whereas for other measures (8 Foot Up and Go) a decrease in values signifies the improvement in physical fitness of older adults (Rikli & Jones, 2001; Seguin et al., 2012).

Data Collection and Data Analysis

Program participants were recruited through newsletters, flyers, word of mouth, Penn State Extension website and other modes of advertisement. For two consecutive years (2011-12 and 2012-13), participants completed the *Senior Fitness Test* [at beginning (pre-test) and end (post-test) of the 12-week program]. Approximately 600 people participated in the first year (2011-12) and 500 in the second year (2012-13) (Table 2).

Table 2.

Details of Data Collection Sites and Number of Participants Completed the Two Year Surveys

Year	No. of Sites	No. of Counties	No. of participants completed the program	No. of participants provided complete data for Senior Fitness Test
2011-12	61	23	3183	601
2012-13	55	22	2390	499

Pre-test and post-test measurements were summarized using means and standard deviations. The change in pre-test and post-test for six physical fitness measures was measured using paired *t*-tests. The data was analyzed using statistical package for social sciences (SPSS version 21.0). According to Oliver and Hinkle (1981), inferential statistics can be used when a population is treated as a sample especially with the presence of other populations with the same characteristics. Based on this justification, the current population serves as a sample of all the individuals who participated in the StrongWomen® program for both years (2011-12 and 2012-13). All the assumptions of paired *t*-test were confirmed. The study was approved by the Institutional Review Board of the Pennsylvania State University.

Results

Respondents pre- and post-health assessment were measured for six physical fitness measures:

- Chair Stand (# in 30 seconds);
- Arm Curl (# in 30 seconds);
- 2-Minute-Step (# of steps);
- Chair Sit and Reach (nearest 1/2 inch + or -);
- Back Scratch (nearest 1/2 inch + or -); and

- 8 Foot Up and go (nearest 1/10 second).

Upon analysis of paired *t*-test, significant differences were found between pre-test and post-tests for all the six physical fitness measures for both consecutive years (2011-12 and 2012-13). The results of Cohen's d for year 2011-12 exhibit that only arm curl (0.51) and back stretch (0.56) resulted in a medium effect size, and the 2012-13 chair stand (0.46) and arm curl (0.52) also resulted in a medium effect size (Cohen, 1988). Detailed descriptions of means, standard deviations, Cohen's d and *t*-test and significance values for both consecutive years (2011-12 and 2012-13) are presented in Tables 3 and 4.

Table 3.

Health Assessment of Six Measures of Physical Fitness for the Year 2011-12

Change in Health Aspects	**Pre test Mean**	**Post test Mean**	**Mean Difference (Post-Pre)**	***df***	***t-value***	***P (<0.05)***	***Cohen's d***
Chair Stand(# in 30 seconds)	19.74 (5.46,515)	22.60 (10.25,515)	2.86	514	7.15	<0.001	0.35
Arm Curl (# in 30 seconds)	21.50 (5.69,527)	24.54 (6.12,527)	3.03	526	17.32	<0.001	0.51
2-Minute-step (# of steps)	107.33 (34.46,398)	117.77 (41.88,398)	10.44	397	9.09	<0.001	0.27
Chair Sit and reach (nearest 1/2 inch + or -)	5.94 (5.37,506)	6.67 (5.12,506)	0.73	505	8.84	<0.001	0.14
Back Scratch (nearest 1/2 inch + or -)	-1.38 (3.95,490)	0.77 (3.72,490)	0.61	489	6.54	<0.001	0.56
8 Foot	4.62	4.36	-0.26	424	-7.39	<0.001	-0.19

Up and go (nearest 1/10 second)	(1.32,425)	(1.31,425)					

Note. Standard deviations and number of participants who responded appear in parentheses below the means

Table 4.

Health Assessment of Six Measures of Physical Fitness for the Year 2012-13

Change in Health Aspects	**Pre test Mean**	**Post test Mean**	**Mean Difference (Post-Pre)**	***df***	***t-value***	***P (<0.05)***	***Cohen's d***
Chair Stand(# in 30 seconds)	18.92 (5.20,222)	21.30 (5.26,222)	2.38	221	7.41	<0.001	0.46
Arm Curl (# in 30 seconds)	20.69 (5.54,220)	23.46 (5.11,220)	2.78	219	9.34	<0.001	0.52
2-Minute-step (# of steps)	111.71 (24.61,65)	120.06 (21.05,65)	8.35	64	2.88	0.005	0.36
Chair Sit and reach (nearest 1/2 inch + or -)	2.16 (3.19,213)	3.13 (2.96,213)	0.97	212	7.08	<0.001	0.32
Back Scratch (nearest 1/2 inch + or -)	-1.73 (3.49,208)	-1.08 (3.58,208)	0.65	207	5.40	<0.001	0.18
8 Foot Up and go (nearest	4.85 (1.38,149)	4.31 (1.47,149)	-0.54	148	-5.59	<0.001	-0.380

1/10 second)							

Note. Standard deviations and number of participants responded appear in parentheses below means.

Discussion, Conclusions, and Implications

Senior Fitness Test data showed consistent improvement in all the six domains of physical fitness over a period of 2 years (2011-12 and 2012-13) across different counties and program sites, exhibiting efficacy of SWP in particular and community-based exercise programs in general. Specifically, participants improved their lower body strength, as measured by significant improvement in post-test for Chair Stand and Chair Sit and Reach measures. The improvement in lower body strength is very important for older adults to perform various basic tasks, such as rising from a chair/seated position unassisted, climbing stairs easily, and walking short distances unassisted. Participants also improved their upper-body strength, which is exhibited by significant increase in number of Arm Curls and Back Stretch. The improvement in upper-body strength helps participants to complete household chores independently and increases ability to take care of self and others and to move easily from one place to other. The significant decreases in time consumed in the post-test for the 8 Foot Up and Go measure demonstrates improved agility and balance while moving. With increased balance older adults are able to maneuver more easily with low susceptibility to falls. The significant increase in number of steps completed in 2 minutes demonstrates the increased aerobic and endurance fitness among older adults.

The most notable finding of the study reported here is the positive evaluation data on community-based educational programs for older adults, which is currently not a strong area in the literature, specifically in the profession of agricultural and Extension education and in the scholarship of engagement. The study also reinforces findings of previous studies by Seguin et al. (2012) and Flickinger (2012), who found significant improvement in physical fitness of SWP participants (older adults). These kinds of significant evaluation findings are required for a program garnering a national presence such as SWP. Due to limited literature on the evaluation of SWP and the reporting of SWP data from very few states like Wisconsin, Massachusetts, and Idaho, it is recommended that Extension professionals conduct frequent evaluation of SWP to add to a national database. These evaluations by Extension professionals across different states will not only help showcase the effects of SWP to funding agencies but might also increase the participation in SWP.

In spite of all these contributions to the literature, the study reported here confronted several challenges or limitations. First, there was no control group to conduct a true experimental study. With the funding constraints and other practical situations, having a control group in community-based programs is challenging. But it is recommended that future researchers should conduct an experimental study using control group to compare changes in six domains of physical fitness as measured by Senior Fitness Test between SWP participants and control group. Other limitation of the study was the utilization of convenience sample (around 20% of total participated in the program) rather than using random sample of participants.

Over and above these limitations, we have seen significant results in our study. It can be inferred from findings of the study that SWP helped participants to improve their body strength, physical fitness, and mobility, and decreased risk of falls and fractures, which indicate the increased independence and quality of life among older adults. Extension is a very successful organization in execution of community-based strength programs such as SWP, which in turn helps older adults across communities in Pennsylvania to improve their quality of life.

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