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Results of a Community-Based Strength Training Program for Women

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Abstract

Only 24 percent of American adults meet strength training recommendations. Furthermore, fewer women than men strength train, and rates decline as they age. Data collected on a six week (12 class) strength training program, Strong Women Stay Young ™ (SWSY ™), showed participants increased arm and leg strength. The purpose of this study was to determine changes in arm and leg strength of women who completed up to 55 strength training classes. At every class, participants recorded the free weights used for three arm exercises and three leg exercises. Participants who initially lifted low (<10 pounds) and medium (10-20 pounds) weights increased arm strength by 54 percent and 21 percent, respectively, and leg strength by 143 percent and 40 percent, respectively. Those who initially lifted high weights (20-30 pounds) decreased arm strength by 4 percent but increased leg strength by 28 percent. This program was effective for individuals with varying levels of arm and leg strength.

Keywords: women, strength training, resistance training

INTRODUCTION

National statistics show that only 24% of American adults meet the twice a week strength training recommendations (U.S. Department of Health and Human Services 2011). Furthermore, fewer women than men strength train, and as they age, strength training rates decline. There are several barriers that prevent women from participating in strength training programs. These include: lack of strength-training programs designed for women, dislike of or intimidation by gyms, long distance to program site, fear of discomfort or injury, lack of social support, and fixed income (Nied and Franklin 2002; Rhodes, Martin, and Taunton 2001).

We found that conducting Strong Women Stay Young (SWSY)TM (Seguin et al. 2008), an evidence-informed, community-based strength training program developed by Tufts University, overcame the barriers mentioned above. The program was designed for mid-life and older women, 40 years and older. It was held in local community settings rather than gyms. Each participant progressed at her own pace which minimized soreness and injury. The cost was nominal and varied per site ($15-$25 for a 6 week program). For many participants, one of the greatest benefits was the social support and interactions that they experienced from the program. Spencer et al. (2012) found that women who attended 12 SWSYTM classes over a six week period significantly improved their arm and leg strength.

The 11 community sites where these 6 week SWSY TM strength training programs were offered compete with other programs for time and space. Therefore, the researchers who taught this program varied in their availability to offer the program, ranging from six weeks or 12 classes to 30 weeks or 60 classes. We were interested in learning how much these women would continue to improve if they attended more than the initial 12 SWSY TM classes.

The primary purpose of this study was to determine changes in arm and leg strength of women who attended more than 12 SWSY TM classes. The authors could find no other studies published that have evaluated SWSY TM strength training progress of participants attending more than 12 classes.

METHODS

Strong Women Stay Young ^{TM} Program

SWSY TM is a strength training program that was developed by Dr. Miriam Nelson at Tufts University (Nelson and Seguin 2004). The 10 researchers that participated in this study attended a SWSY TM workshop before the study began, were trained to teach the strength training classes, and instructed on the research protocol. The classes were held for one hour twice a week and were offered in six week increments at community sites which were University of Idaho Extension offices. In each class, the participants used free weights to complete two sets of 10 repetitions for each of the six strength training exercises. The researchers collected strength training data on their participants at each class. At the beginning of the study, 10 researchers taught the first set (12 classes) of SWSY TM classes. During the rest of the study, 6 researchers taught a second and third set (13-37 classes) of SWSY TM classes and 3 researchers taught a fourth and fifth set (37-60 classes) of SWSY TM classes.

Participants

A convenience sample of adult women ages 18 and older with varying strength training experience (from 0to more than 5 years of experience) participated in the study. They were recruited to attend the SWSY TM classes using flyers, newspaper advertisements, newsletters and county Extension websites. Participants were screened using the Physical Activity Readiness Questionnaire (PAR-Q) (Shephard 1988) and completed a Participant Consent Form. The study was approved by the University of Idaho Institutional Review Board.

Data Collection

The University of Idaho Institutional Review Board approved this study from October 28, 2010 to December 6, 2012. The data collection period for this study lasted from January 1, 2011 to December 1, 2012.

We gathered initial information on each participant's age, race, ethnicity, and class location and had them complete a strength training log form to self-record the weights they used for each exercise. Strength training progress was monitored over the course of the SWSY TM program by having each participant record the free weights they lifted in one pound increments (ranging from one pound to 20 pounds) at each class. For each exercise, the weight that was recorded was the amount lifted by one arm or leg (e.g. 5 lbs was recorded if they used a 5 lb weight with each arm or leg). They recorded the weight they lifted for three arm exercises (biceps curl, bent forward fly, and overhead press) and three leg exercises (standing leg curl, knee extension, side hip raise). The instructors monitored the participants while they completed their strength training log to ensure they were recording the correct amount of weight. Participants were asked to comment on why they attended the SWSY TM classes.

Statistical Analysis

A paired control design was used, whereby participants served as their own control, as a way to reduce variability, and have a more precise comparison with fewer participants as a way to measure their strength-training progress (Dallal 2007).

We used the statistical software R, version 3.03, to analyze the data (R Core Team 2013). Multiple regressions were used to assess the performance of the participants by modeling (predicting) their final arm and leg strength as a function of *a priori* variables. To do this, we first aggregated the data for the three arm and three leg exercises and summed the final weights for each. Two multiple regression models were fit to these data and were similar in structure. They were used to estimate the final weight lifted or dependent variable (W_j: arms or legs) by participants during the SWSY ^{TM} program. The models were expressed as:

$$W_f = \beta_0 + \beta_1 \cdot W_i + \beta_2 \cdot T + \beta_3 \cdot A + \beta_4 \cdot (W_i \cdot T) + \varepsilon$$

where β_0 is the intercept, and the remaining β's are the coefficients to be estimated for each independent variable (or covariate): (1) W_i is the ($\log_e$) initial weight lifted on her FIRSTclass and is used as a measure of the women's inherent athletic ability and prior exercise experience (Karp 2001); (2) T is the total number of strong woman classes that were attended and provides a measure of participation, (3) A is the woman's age, and (4) $W_i \cdot T$ is the interaction between initial weight lifted and number of classes attended. Because we used the initial weight the woman lifted in this model, each participant served as their own control. We log-transformed W_f and W_i to account for the expected heteroscedastic or unequal variance between these variables (i.e., greater error with greater weight lifted).

To determine how the four covariates related to one another and assess potential interactions, we aggregated the arm and leg strength data into two categories. The first category was the amount of weight participants lifted on their initial class: Low (< 10.0 pounds), Medium (10.1 to 20 pounds) or High (20.1 to 30 pounds). The second category was the number of classes attended: 2-12, 13-24, 25-36, and 37-55. These were based on the strength training program being offered as 12 class intervals.

RESULTS

Participants

Age, race, and ethnicity information were collected at the first class. There were 241 participants and approximately 98 percent (238) were white, 1 percent (3) was Native American, and 1 percent (3) was Asian. Of those who responded (n = 241), 2 percent (4) were Hispanic. Participant mean age was 63, with the participants ranging from 29 to 89 years old.

The number of participants that completed the SWSY TM classes declined throughout the study. There were 161 participants that provided strength training data for 1-12 classes, 49 participants for 13-24 classes, 13 participants for 25-36 classes and 13 participants for 37-55 classes.

Multiple regression results

The multiple regression results (in Tables 1 and 2) show that four variables significantly affected the mean final arm and leg weight the women could lift. Two variables, initial weight lifted and class attendance, had a significant positive ($p < 0.001$) effect. The lower the initial weight lifted and the more classes they attended, the greater the final arm and leg weight lifted.

The other two variables, age and interaction between initial weight lifted and classes attended, had a significant negative impact on the final weight lifted. As the age of the participants increased, there was a slight decrease in final weight lifted for both arm (β4- arm = -0.005, SE=0.002) and leg exercises (β4- leg -0.006, SE=0.003). The interaction between initial weight lifted and classes attended was dependent on whether they initially lifted a low or high weight. If they lifted a low weight initially and increased the number of classes attended, their final arm and leg strength increased. But if they lifted a high weight initially and increased the number of classes attended, their final arm and leg weight did not increase.

Arm and Leg Strength

Tables 3 and 4 list the final arm and leg weight participants lifted, based on the interaction of the two variables, initial weight lifted (low, medium, high) and number of strength training classes attended. Participants' mean arm and leg strength were based on the initial weight lifted on their first class as low (< 10 pounds), medium (10-20 pounds), and high (20-30 pounds). Within each of these initial weight categories, the mean final weights were calculated after completion of 2-12, 13-24, 25-36, and 37-55 classes.

After completing 2-12 classes, participants in the low, medium, and high weight lifting groups had mean arm strength of 12.59 pounds, 18.4 pounds, and 26.17 pounds, respectively. Women who initially lifted low and medium weights continued to increase their arm strength after completing between 13-24, and 37-55 classes. Arm strength plateaued if they completed 25-36 classes. By the end of the study, women in the low and medium weight lifting groups increased their arm strength by 6.8 pounds (54 percent) and 3.9 pounds (21 percent), respectively. For women in the high weight group, the weight lifted was virtually the same after completing 2-12 and 37-55 classes and decreased after completing 13-24 and 25-36 classes.

Overall, all three weight lifting groups saw increases in leg strength by the end of the study. After completing 2-12 classes, women in the low, medium, and high weight lifting groups had mean leg strength of 12.32 pounds, 19.48 pounds, and 23.4 pounds, respectively. Their mean leg strength increased if they completed 13-24 classes. Leg strength plateaued in the low and medium weight lifting groups if they completed 25-36 classes but increased if they completed 37-55 classes. For women in the high weight lifting group, their leg strength increased to 33 pounds if they completed 13-24 classes and stayed relatively constant for the rest of the study. At the end of the study, women in the low and medium weight lifting groups increased their leg strength by 17.68 pounds (143 percent) and 7.81 pounds (40 percent), respectively.

Participant Comments

When asked why they attended the SWSY^{TM} classes, participants who attended 12 classes reported it was mainly because they felt stronger and better and it increased their ability to complete other daily activities (gardening, playing with grandchildren, lifting groceries, etc) (Spencer et al. 2012). Participants who attended more than 12 classes reported a strong positive connection with other participants. They commented, "the joy, laughter, and friendship is wonderful," "this program builds not only strong women but also happy ladies," and "we have great care for each other, with great compassion, tenderness and humor. Our tummy muscles get a great workout from laughing and our tear ducts from greater tender compassion."

DISCUSSION

Four factors – age, initial weight lifted, number of classes attended, and interaction between initial weight lifted and classes attended - played a role in the final weight participants lifted. In our study, we found age had a slight negative effect on final weight lifted. This could be due to sarcopenia or the loss of skeletal muscle mass and strength which occurs as people age (Visser 2009; Roger and Evans 1993). Class participation helped offset the negative effect age had on final weight lifted. As participants attended more strength training classes, the final weight they lifted also increased. This could be due to muscle fiber hypertrophy that occurs when women strength train (Charette et al. 1991; Cress et al. 1991).

The last two variables, the interaction between initial weight lifted and classes attended, affected strength training progress. By the end of the study, those who initially lifted low and medium weights had the greatest increase in arm and leg strength while those who initially lifted heavier weights maintained their arm and leg strength and did not progress. This indicates that the SWSY TM program could be useful for women who want to increase arm and leg strength or maintain their strength training abilities.

Even though arm and leg strength increased by the end of the study for the low and medium weight lifting participants, there were several surprising strength training progressions and plateaus that emerged. We found that the greatest increases in arm and leg strength occurred at two intervals, after 24 classes, (approximately three months) and after 55 classes (approximately 6.875 months). These results contrasted with Morganti et al. (1995) who found that 60 year-old women who strength trained for one year had most of their strength training increases occur during the first three months.

Participants experienced strength training plateaus, and in some cases, decreases in strength between 25-36 classes. Reasons why this occurred could have been due to participants injuries, illness, missed classes, voicing reluctance to try heavier weights for fear of injury, boredom, decrease in motivation, and their neuromuscular system adapting to the exercises (Häkkinen et al. 2000). Elsangedy et al. (2013) found that older women (mean age of 65.6) self-select weights

below the amount needed to improve their strength. The structure of the exercise program could have also played a role. All of the SWSYTM classes were the same and Galvao and Taaffe (2004) found that the best strategy for improving strength was to alter frequency, intensity, and volume of the exercises.

Strength training is important to help prevent falls and treat chronic disease conditions in the elderly (Seguin and Nelson 2003). The majority of our participants were between 55-70 years old, and taking these classes could play a role in preventing falls that occur annually in 1 of 3 Americans who is 65 and older (Centers for Disease Control and Prevention 2012). Chronic health conditions that affect this age group include arthritis, obesity, diabetes, low bone mass, and heart disease (U.S. Department of Health and Human Services 2011). Numerous participants commented that the classes made them feel better and some mentioned that it improved their flexibility, blood pressure, and blood sugar levels. Strength training has been shown to be effective in helping to treat numerous chronic diseases (Klein, Burr, and Stone 2005).

Class participation results were not as positive as the strength training results. Participation decreased from a mean of 161 participants attending classes 1-12 to a mean of 13 attending classes 37-55. The main reason for the drop in participation was the decrease in the number of researchers offering the SWSY classes in their counties. Other reasons could have been declining interest in doing the same exercises at each class, lack of motivation, and observing smaller changes in their strength training ability. We speculated that participation would be improved once they made strength training a habit. The researchers encouraged this by having participants focus on: (1) making strength training a priority, (2) setting realistic strength training goals, and (3) monitoring progress towards those goals.

Limitations

There were three limitations noted in this study. The first is that there was a high attrition rate over the course of the study. The second is that this sample population is not representative of the U.S. general population and these results may not apply to the general population. The third is that this study was done only on women, and a similar study of men might not yield similar results.

Implications for Research and Practice

SWSY^{TM} classes were effective for women who began the program with varying levels of arm and leg strength. Those who initially lifted low and medium heavy weights had the greatest increase in arm and leg strength, but it also helped individuals who lifted heavier weights maintain their level of arm and leg strength.

There is a growing need for strength training programs for women to reduce the risk of osteoporosis and other chronic illnesses. Our research supports the theory that the longer one participates in a strength training program the stronger one becomes which leads to longer, more independent life. This program has potential to be duplicated nationally in other rural and urban communities.

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Table 1. Statistics for ANCOVA models on the final weight lifted during arm exercises by participating women in the SWSY ™ program

Variables	**Estimate (Beta Coefficient values)**	**SE**	**t-value**	**P-value**
(Intercept)	1.400	0.204	6.9	<0.001
Initial weight lifted - W_i	0.668	0.064	10.4	<0.001
Total class attendance - T	0.036	0.009	4.0	<0.001
Age - A	-0.005	0.002	-2.7	0.007
Interaction - $W_i \cdot T$	-0.012	0.004	-3.1	0.002

Table 2. Statistics for ANCOVA models on the final weight lifted during leg exercises by participating women in the SWSY ™ program

Variables	**Estimate (Beta Coefficient values)**	**SE**	**t-value**	**P-value**
(Intercept)	1.199	0.262	4.6	<0.001
Initial weight lifted - W_i	0.753	0.078	9.7	<0.001

Total class attendance - T	0.072	0.011	6.5	<0.001
Age - A	-0.006	0.003	-2.2	0.030
Interaction - $W_1 \cdot T$	-0.022	0.004	-5.1	<0.001

Table 3. Summary of the mean total weights lifted and standard error during arm exercises among SWSY participating women by category of the initial weight lifted and the number of classes attended

Final arm weight lifted by number of classes attended								
Initial weight lifted (Class 1)	Classes 2-12		Classes 13-24		Classes 25-36		Classes 37-55	
	Mean weight	SE	Mean weight	SE	Mean weight	SE	Mean weight	SE
Low: < 10 lbs	12.59	0.43	15.91	1.224	15.33	2.092	19.4	2.015
Medium: 10.1 – 20.0 lbs	18.4	0.563	20.5	1.197	20.6	2.088	22.43	1.716
High: 20.1 - 30 lbs	26.17	1.537	22.6	0.812	19	0	25	0

Table 4. Summary of the mean total weights lifted and standard error during leg exercises among SWSY participating women by category of the initial weight lifted and the number of classes attended

Final leg weight lifted by number of classes attended								
Initial weight lifted (Class 1)	Classes 2-12		Classes 13-24		Classes 25-36		Classes 37-55	
	Mean weight	SE	Mean weight	SE	Mean weight	SE	Mean weight	SE
Low: < 10 lbs	12.32	0.603	21.72	1.853	16.5	2.901	30.45	3.406
Medium: 10.1 - 20 lbs	19.48	1.001	24.67	1.819	21.6	2.4	27.29	3.572
High: 20.1 - 30 lbs	23.4	1.47	33	1.08	33.5	1.893	30.	0