JACOBS PUBLISHERS

OPEN ACCESS

Jacobs Journal of Sports Medicine

Review Article

Effectiveness of the Strong Women Strong Bones ™ Strength Training and Nutrition Education Program

Raidl M[1*], Spencer M[1], Sant L[1], Lockard M[1], and Plumb J[1]

[1]*University of Idaho, USA*

**Corresponding author: Dr. Martha Raidl, University of Idaho, Boise, 322 East Front Street, Suite 180, Boise, ID. 83702, USA, Tel: 208-364-4056; Email: mraidl@uidaho.edu*

Received: 03-01-2015

Accepted: 03-24-2015

Published: 05-21-2015

Abstract

Forty one middle-aged women enrolled in the six-week, 12 class, Strong Women Strong Bones™ strength training and nutrition program. For the 17 women who attended all 12 classes, they significantly increased their arm strength by 30-78 percent and leg strength by 230 percent. Calcium intake remained constant, at approximately 5.5 servings per day.

Keywords: Strength Training; Calcium Intake; Women

Abbreviations

SWSB: Strong Women Strong Bones;
SWSY: Strong Women Stay Young;
SWP: Strong Women Program

Introduction

Women in their forties begin to experience a decline in muscle strength [1] and bone density [2], both of which accelerate with age. One of the factors contributing to the decrease in muscle strength is that few women in their forties, just 14.5 percent, meet the twice a week strength training recommendations. This further declines to 9.1 percent by the time they are 75 years-old [3]. Adequate calcium intake in childhood that continues into adulthood plays a role in bone density. Unfortunately, many women do not meet the calcium intake recommendation of 1000 milligrams per day [4] during adulthood. The most recent food consumption data collected from the National Health and Nutrition Examination Survey (NHANES) showed that median dietary calcium intakes in women was low in adulthood, at 686 mg/day when they were 19-30 years-old, and progressively decreased to 589 mg/day when they were > 81 years-old [5].

To combat these two problems, the University of Idaho (UI), offered an evidence-based strength program, Strong Women Strong Bones (SWSB) ™, which combined strength training classes with nutrition information on how to preserve bone density, in three communities. These three communities were selected because they had UI faculty called Family and Consumer Sciences Extension (FCS) educators who were certified to teach the program. The purpose of our project was to determine if participants increased their muscle strength and their calcium intake after attending classes twice a week for six weeks.

Methodology

Subjects

A convenience sample of 41 adult women ages 18 and older enrolled in the study in 2012. They were recruited to attend

the SWSB ™ classes from flyers, newspaper advertisements, newsletters and county extension websites. Participants were screened using the Physical Activity Readiness Questionnaire (PAR-Q) [6] and completed a Subject Consent Form. The study was approved by the University of Idaho Institutional Review Board. Demographic (age, race, and ethnicity) and strength training data were collected on each participant at the first class.

Strong Women Program (SWP): Strong Women Strong Bones ™

The Strong Women Program (SWP), designed by Dr. Miriam Nelson and colleagues at Tuft's University, is a strength training program that targets midlife to older women and is conducted in a community setting. It is comprised of two separate strength training programs, Strong Women Stay Young (SWSY) and Strong Women Strong Bones (SWSB) [7]. We have previously tested the effectiveness of the SWSY ™ programs [8,9] and were interested in determining effectiveness of the SWSB ™ program which was designed to reduce the risk of developing osteoporosis and improve bone health at any age. It was taught in three counties in Idaho by University of Idaho faculty called FCS Extension educators who were certified to teach the classes and were trained to conduct research-based community programs [8,9].

Description of the classes and data collection

During the six-week SWSB ™ program, subjects attended classes at Extension offices twice a week for a total of 12 classes. Each class lasted one hour and had two components. In the first component, which lasted 45 minutes, participants completed a warm-up, five strength-training exercises and a cool down. The strength training exercises included four arm exercises - biceps curl, chest press, overhead press, and bent forward fly- and one leg exercise (the side leg raise). Three exercises (biceps curl, overhead press, bent forward fly) were done standing up or sitting in a chair and two exercises (chest press and side leg raise) were done on the floor. At each class, subjects recorded the weights that they used for each exercise which was monitored and collected by the FCS extension educators.

In the second component, which lasted 15 minutes, participants received nutrition information on preserving bone density that focused on sources of calcium-rich foods and how to incorporate them into the diet. They learned about three categories of calcium-rich foods which included: (1) dairy sources (milk, cheese, and yogurt), (2) non-dairy sources (greens, soybeans/cow beans/white beans, and canned fish with bones) and (3) calcium-fortified foods (orange juice, cereals, tofu, and other foods) [10]. Participants completed a retrospective food frequency questionnaire that asked them to record their daily or weekly intake of 12 calcium-rich foods that fell into the three categories at the last class (post) and their intake before (pre) beginning the program. The retrospective design was used because it accounted for changes in learners' behavior by allowing participants to first report current dietary behaviors (post) and then compare them to those same behaviors just before (pre) they received the nutrition education intervention [11].

Statistical Analysis

Frequencies and means were calculated on participants' demographic and strength training experience. A paired control design was used, with participants serving as their own control, as a way of measuring their strength training progress and decreasing variability within the smaller sample size [12]. Paired t-tests were used to evaluate strength-training results and calcium intake. Since, previous research strongly supported greater lifting ability as result of the SWSY ™ program, we used a one-tailed test for the strength training comparisons, but used a two-tailed tests for dietary comparisons. Also, since we conducted five family-wise strength training tests, we used the conservative Bonferroni correction to the significance level so that α=0.01 (i.e., 0.05/5 = 0.01) across the five strength training tests, and α= 0.004 (i.e., 0.05/12 = 0.004) across the 12 dietary tests.

Results

Description of the participants

The results in Table 1 showed that the vast majority of women who participated in the study were white and had a mean age of approximately 65 years. Also, approximately 75% had prior strength training experience before taking the SWSB ™ class, most of them having participated in another Strong Women program (i.e. Strong Women Stay Young).

Table 1. Participant Demographic and Strength Training Information

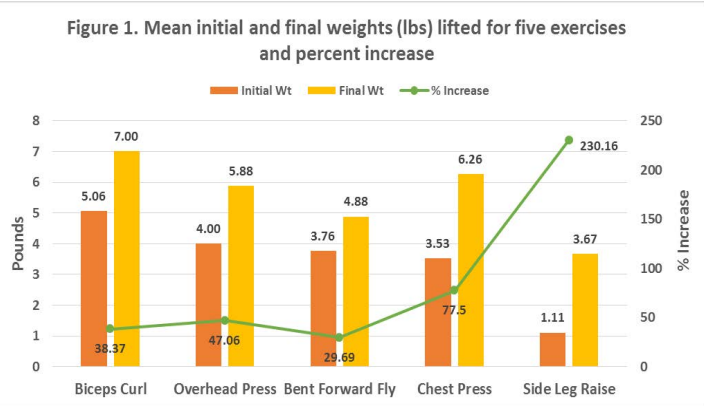
Item	Number
Total number of Participants	41
Number of counties	3
Mean Age (SE) (years)	65.2 (1.7)
Race and Ethnicity	
American Indian or Alaskan Native	1 (2.4%)
Asian	2 (4.8%)
Black or African American	0
Native American or other Pacific Islander	0
White	38 (92.6%)
Hispanic	1(2.4%)
Strength Training background	
Number that have strength training experience before starting SWSB program	31 yes, (75.6%) 10 no (24.4%)
Number (%) that participated in other Strong Women programs	24 yes (58.5%) 17 no (41.5%)
Months strength training experience (SE)	18.4 (2.8)

Strength training results

The one-tailed t-test was used to determine if there was a significant change in the amount of weight subjects used for the five exercises, from Class 1 to Class 12. There were 17 subjects who completed all twelve classes and provided data on the weight they lifted. Table 1 and Figure 1 show that the amount of initial and final weight lifted varied with each exercise. The initial weight lifted ranged from 1.11 lbs, for the side leg raise, to 5.06 lbs, for the biceps curl. Similarly, for the final weight lifted, it ranged from 3.67 lbs, for the side leg raise, to 7.0 lbs for the biceps curl. Table 2 and Figure 1 show the percent increase in weight lifted, for each exercise, varied from 29% (bent forward fly) to 230% (side leg raise). All of the p-values were less than 0.01, indicating that participants significantly increased the amount of weight lifted for each exercise after attending 12 SWSB TM classes.

Table 2. Mean (SE) initial and final weights (lbs) lifted, for five exercises, percent increase, t-values, and P-values

Exercises	N	Initial weight (lbs) (SE) Class 1	Final weight (lbs) (SE) Class 12	Percent increase (%)	t-value	p-value (one-tailed)
Biceps curl	17	5.06 (0.95)	7 (0.85)	38.37	4.67	0.0001
Overhead press	17	4 (0.55)	5.88 (0.63)	47.06	3.72	0.0009
Bent forward fly	17	3.76 (0.55)	4.88 (0.56)	29.69	3.27	0.0024
Chest press	17	3.53 (0.31)	6.26 (0.81)	77.50	4.05	0.0005
Side leg raise	17	1.11 (0.46)	3.67 (0.59)	230.16	3.74	0.0009



Calcium intake results

A paired t-test was used to determine if participants either changed their total intake of calcium-rich foods or if they changed the source of calcium-rich foods they consumed. Table 3 shows participants did not significantly change their total intake or source of calcium-rich foods.

Table 3. Pre and post daily intake of calcium-rich foods.

Food categories and calcium-rich food items	N	Mean servings Pre (SE)	Mean servings Post (SE)	Difference [post-pre] (SE)	*P*-value (*t*-test)
Dairy					
Milk	20	1.386 (0.232)	1.543 (0.274)	0.157 (0.126)	0.228
Yogurt	15	0.657 (15)	0.733 (0.217)	0.076 (0.083)	0.377
Cheese	20	0.85 (0.18)	0.964 (0.22)	0.114 (0.07)	0.119
Vegetables					
Greens (collards, kale)	21	0.585 (0.208)	0.667 (0.239)	0.082 (0.067)	0.239
Soybeans, cowpeas, white beans	21	0.374 (0.148)	0.429 (0.191)	0.054 (0.053)	0.313
Canned fish with bones					
Sardines	20	0 (0)	0 (0)	0 (0)	NA
Salmon	21	0.306 (0.188)	0.177 (0.059)	-0.129 (0.144)	0.381
Calcium-fortified foods					
Orange Juice	18	0.675 (0.385)	0.675 (0.384)	0 (0.012)	1.000
Soy Milk	20	0.05 (0.05)	0.079 (0.056)	0.029 (0.029)	0.330
Ready to eat foods	20	0.471 (0.089)	0.429 (0.089)	-0.043 (0.056)	0.453
Tofu	21	0.027 (0.021)	0.027 (0.021)	0 (0)	1.000
Other foods	18	0.595 (0.278)	0.357 (0.133)	-0.238 (0.172)	0.184
Total intake	21	5.476 (0.965)	5.578 (0.917)	0.102 (0.192)	0.602

On average, participants consumed just over 5.5 servings of calcium-rich foods per day, with the majority coming from dairy foods, especially milk. This was followed by calcium-fortified foods (orange juice) and non-dairy calcium rich foods (greens), with canned fish with bones having the smallest intake.

Discussion

The purpose of our project was to determine if participants increased their muscle strength and their calcium intake after attending Strong Women Strong Bone classes twice a week for six weeks. The results showed that muscle strength increased while calcium intake remained relatively constant.

The mean age of the SWSB ™ participants was approximately 65 years-old, indicating it was successful in attracting the target audience of midlife to older women (7). Approximately 75 percent of the participants had previous strength-training experience which is much higher than the national average of 11 percent in women 65 years-old who meet strength-training recommendations. This higher percentage was due to 60 percent of women had previously enrolled in a Strong Women class. Reasons why they enrolled in the SWSB ™ could have been that they found the Extension setting to be less threatening than a gym and found the group, consisting of mainly older women, provided them with the social support that they needed and enjoyed (8,13).

There were five strength training exercises that were monitored. Three exercises (biceps curl, overhead press, and bent

forward fly) were completed either standing or sitting on a chair and two exercises (chest press and side leg raise) were completed on the floor. At the beginning of the study, participants commented on the difficulty of completing the floor exercises. It is estimated that approximately 80 percent of elderly individuals have difficulty getting up off the floor (14). That may be why approximately 40 percent (17 out of 41) of our participants completed all 12 SWSB ™ classes. Participants may have had difficulty getting down on the floor for the chest press and side leg raise, and then getting up after the exercises. However, for those individuals who completed all 12 classes, the greatest increase in muscle strength occurred in the two floor exercises, 230 percent increase for the side leg raise and 77 percent increase for the chest press. For the exercises that were completed sitting or standing, muscle strength increased significantly, by 29 percent (bent forward fly) to 47 percent (overhead press). The greatest increase in muscle strength (230 percent) that occurred with the side leg raise may be due to greater blood flow and oxygen uptake by leg muscles and faster breakdown of muscle glycogen in arm muscles causing earlier muscle fatigue (15).

Calcium intake remained relatively constant, from the beginning to the end of the study, at approximately 5 ½ servings/day. Participants obtained their calcium intake from mainly two sources, dairy foods (mainly milk) and calcium-fortified foods. Their consumption of milk at 1 ½ servings is approximately twice as high as the national estimates of 0.8 servings/day (16). It's unknown if the 5 ½ servings of calcium rich foods participants reported on the calcium intake survey met the Recommended Dietary Intake of calcium. A more detailed food intake record would need to be used which was beyond the scope of this study.

The nutrition topics that were covered in the class focused on giving participants other options for consuming calcium rich foods, such as vegetables (including collards, kale, beans) and canned fish with bones, and providing them with links to recipes. There were no activities to get the participants involved with using and applying the information. A more effective approach may be to incorporate active learning into the nutrition class, e.g. have them brainstorm how to include a variety of calcium-rich foods into their diet or demonstrate how to prepare a calcium-rich recipe and share it in class (17). Another reason why calcium intake did not increase significantly is that at the beginning of our study, a high percentage (76 percent) of our subjects were already active and physical activity has been linked to improved eating behaviors (18). They may have made healthier changes to their diet before enrolling in this program.

There were three limitations with this study. The first was that it was a convenience sample; the second was that sample size was small, and composed solely of middle-aged women. Therefore the results are not representative as a subset of the U.S. population. The third limitation was the short time period of the study, six weeks. It is unknown if the participants would continue to do the strength training exercises on their own and continue to improve or maintain their increase in arm or leg strength.

Current Trends

The SWSB ™ program meets many of the current trends in the health and fitness industry (19). It is relatively small in size, averaging 8-12 participants per class. The classes are held locally, are convenient, and designed to be non-intimidating. SWSB ™ classes meet a specific niche, i.e., targeting middle-aged or older women and focusing on 'functional fitness,' helping participants complete daily activities safely and effectively. With the advent of some doctors beginning to prescribe physical activity to their patients (20), more patients may start including physical activity, and especially strength training, into their daily lives.

Conclusion

The SWSB ™ program strength training and nutrition education program was effective in increasing women's arm and leg strength in a relatively short time and did not change their intake of calcium-rich foods.

Acknowledgements: Funding for this project was provided by the National Institute of Food and Agriculture (NIFA), as part of a University of Idaho Hatch Project.

References

1. Nair KS. 2005. Aging muscle. In A J Clin Nutr. 2005, 81: 953-63.

2. Berger C, Langse™ http://www.ncbi.nlm.nih.gov/pubmed pubmed/23987804 o L, Joseph L, Hanley D, Davison, SK. et al. Change in bone mineral density as a function of age in women and men and association with the use of antiresorptive agents. In Can Med Assoc J. 2008, 178 (13): 1660-8.

3. U.S. Department of Health and Human Services. Health, United States, 2011. Washington (DC): Centers for Disease Control and Prevention, National Center for Health Statistics. 2011.

4. IOM (Institute of Medicine). Dietary Reference Intakes for Calcium and Vitamin D. Washington, DC: The National Academies Press. 2011.

5. Mangano KM, Walsh, SJ, Insogna KL, Kenny AM, Kerstetter J. Calcium intake in the United States from dietary and supplemental sources across adult age groups: New estimates from the National Health and Nutrition Examination Survey 2003-

2006, In J Am Diet Assoc. 2011, 111(5): 687-695.

6. Shephard RJ. PAR-Q, Canadian home fitness test and exercise screening alternatives. In Sports Med 1988, 5(3): 185-195.

7. Nelson ME, Seguin RA. The Strong Women Tool Kit: A Program Leader's Guide to Conducting Strength Training Programs for Women. Medford (MA): Tufts University. 2004, 25-100.

8. Spencer M, Sant L, Hampton C, Lanting L, Liddil A, Lockard M, Peutz J, Wit™an G, Woffinden S, and Raidl M. Effectiveness of the six week Strong Women Stay Young Program. In FFCI. 2012,17(2).

9. Sant, L, Spencer M, Hampton C, Lockard M, Peutz J, Raidl M, Plumb J. Results of a community-based strength training program. In FFCI 2014, 20(2).

10. U.S. Depar™ent of Agriculture, Agricultural Research Service. USDA National Nutrient Database for Standard Reference, Release 26, 2013.

11. Rockwell, SK, Kohn H. Post-then-pre evaluation. In JOE 1989, 27(2).

12. Dallal GE. Paired data/paired analyses, 2007.

13. Seguin R, and Nelson ME. The benefits of strength training for older adults. In A J Prev Med 2003,25 (Suppl 2): S14-19.

14. Fleming J1, Brayne C. Inability to get up after falling, subsequent time on floor, and summoning help: prospective cohort study in people over 90, In BMJ. 2008, 337:a2227.

15. Ahlborg G and Jensen-Urstad M. Metabolism in exercising arm vs leg muscle. In Clin Physiol 1991, 11(5): 459-468.

16. Economic Research Service. Trends in U.S. per capita consumption of dairy products, 1970-2012, 2014.

17. Sahyouun N, Pratt C, and Anderson A. Evaluation of nutrition education interventions for older adults: A proposed framework. In J Am Diet Assoc 2004, 104: 58-69.

18. Joseph RJ, Alonso-Alonso M, Bond DS, Pascual-Leone A, and. Blackburn GL. The neurocognitive connection between physical activity and eating behavior. In Obes Rev 2011, 12(10): 800-812.

19. Peterson J. Take ten:Take-and-save: 10 current trends in the health and fitness industry. In ACSM's Health & Fitness Journal 2004, 8(6): 44-45.

20. Persson G, Brorsson A, Hansson E, Troein M, and Standberg E. Physical activity on prescription (PAP) from the general practitioner's perspective – a qualitative study. In BMC Family Practice 2013, 14: 128-135.