Strength Training in Older Adults: An Empowering Intervention

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ABSTRACT

KATULA, J. A., M. SIPE, W. J. REJESKI, and B. FOCHT. Strength Training in Older Adults: An Empowering Intervention. *Med. Sci. Sports Exerc.*, Vol. 38, No. 1, pp. 106–111, 2006. **Purpose:** This study evaluated the benefits of adding a psychological empowerment intervention (PEI) to traditional strength training (TST) on social cognitive variables in community-dwelling older adults. **Methods:** Thirty-eight participants were randomly assigned to either a PEI or a TST intervention for 6 wk. Before random assignment and following training, participants completed measures of self-efficacy for upper and lower body strength as well as the desire to be able to lift specific amounts of weight. Both treatments involved two sessions per week of center-based training and one session per week of home-based training. The PEI condition also included a group-mediated intervention that was designed to increase self-efficacy for physical strength and the desire for upper and lower body strength. **Results:** General linear models on difference scores revealed that the two groups experienced differential gains in the desire for upper body strength ($P = 0.023$, effect size (ES) = 0.79) and were marginally different in gains for upper body strength self-efficacy ($P = 0.065$, ES = 0.63). On a four-point scale, the adjusted mean (±SE) differences for the PEI group on the desire for upper body strength was 0.71 (±0.12) as compared to 0.27 (±0.13) for the TST group, whereas the PEI group's improvement in self-efficacy for upper body strength was 25.70 (±3.02) as compared to 17.18 (±3.19) for the TST group. **Conclusions:** Empowerment-based exercise programs may be particularly motivating for older adults by creating a more meaningful physical activity experience for them. **Key Words:** AGING, SARCOPENIA, SELF-EFFICACY, DESIRE

There is increasing evidence that age-related sarcopenia is a major contributing factor to the disablement process (9,10). Sarcopenia has been found to affect many aspects of physical function, including gait and balance problems, increased fall risk, and loss of functional independence (9,10). Furthermore, advanced muscle loss may affect quality of life, the need for supportive services, and, ultimately, the need for long-term care in older individuals (4,8). Several randomized, controlled trials have demonstrated that progressive resistance training can safely increase muscle mass and strength in older adults and improve functional health outcomes (6,19). However, it is becoming increasingly clear that the positive effects physical activity programs have on older adults' physical function are due, in part, to elements of psychological empowerment (16,17) such as a sense of personal competence and a desire for and a willingness to take action (23). For example, there is evidence that physical activity programs can be designed to enhance self-efficacy beliefs (12), and recent research with older adults has shown that a group-mediated cognitive behavior intervention promotes the motivation and skills that are essential to long-term behavior change (16).

In this study, we examine whether older adults' personal competence and desire for muscular strength can be facilitated through the use of a group-mediated cognitive behavior intervention that is coupled with strength training. This line of work is important because there are aging stereotypes that serve as disincentives for older adults to participate in strength training (14). We hypothesized that a weight training program integrated with a group-mediated psychological empowerment intervention would produce greater self-efficacy beliefs related to muscular strength and to a greater desire to possess muscular strength than a traditional regimen of weight training.

METHODS

Participants

Participants were recruited via advertisement at local malls and in local newspapers. Eligibility criteria included (a) older than 60 yr of age, (b) sedentary, (c) self-reported difficulty in one or more activities of daily living that require ambulation, and (d) stable residence for 3 months. Exclusion criteria included (a) psychiatric illness, (b) severe symptomatic heart disease, (c) systemic disease, (d) active cancer, (e) hearing or sight impairment, (f) cognitive impairment, (g) alcoholism, (h) the inability to walk unassisted, and (i) failure to pass the physical activity readiness questionnaire. Of the 45 individuals initially tested, three were unable to participate based on clinical judgment, and four individuals dropped out during the training program

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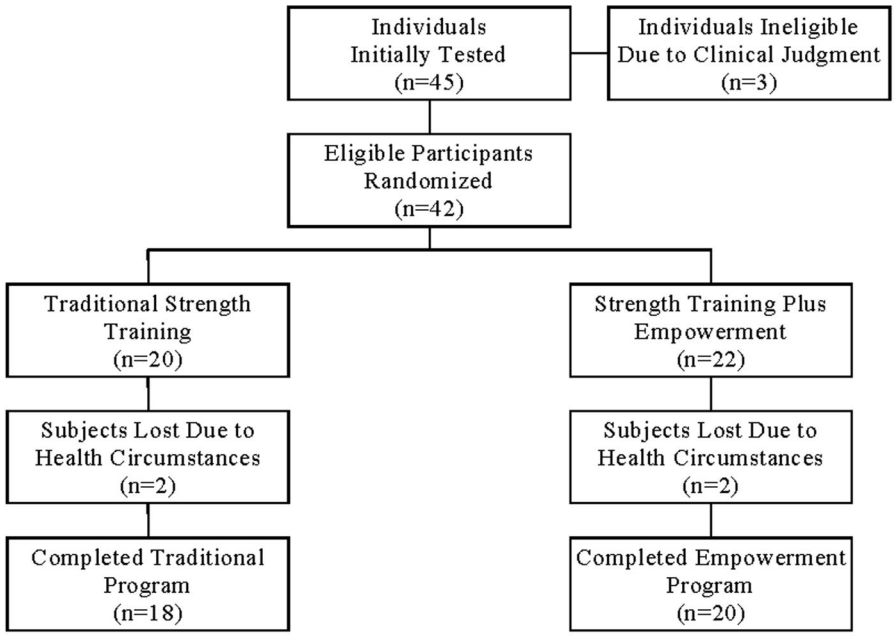

FIGURE 1—Participant breakdown.

due to various health reasons (Fig. 1). The final group of participants in the study consisted of 12 males and 26 females, ranging in age from 60 to 81 yr (mean = 70.50, SD = 5.32).

Overview of the Study

The study was designed to compare a traditional strength-training program (TST) with one that was supplemented by a psychological empowerment intervention (PEI) on self-efficacy and the desire for physical strength. All participants engaged in the same 6-wk weight-training routine; however, the PEI treatment arm was exposed to a group-based psychological empowerment program. Both treatment conditions (TST and PEI) met for 2 d each week for center-based training and completed 1 d of home-based training each week.

Measures

The outcome measures for this study were developed in a manner consistent with the principles of measurement from social cognitive theory (3) and were collected by personnel that were blinded to treatment assignment. These included the following:

Strength efficacy. Participants were assessed on how much certainty they had in their ability to successfully lift various amounts of weight for both an arm curl and a lower leg extension. Participants stood with five different weights in front of them on a table. The weight increments for males for the arm curl were 5, 8, 12, 15, and 20 lb and for leg extension 5, 7.5, 12.5, 20, and 25 lb. The weight increments for females for the arm curl were 3, 5, 8, 12, and 15 lb and for leg extension 2.5, 7.5, 10, 15, and 20 lb. Participants performed one repetition with the dominant arm or leg on the lightest weight and then completed questions related to that weight. The questionnaire asked for confidence ratings, ranging from 0% ("not at all certain") to 100% ("completely certain") in lifting the weight 2, 4, 6, 8, and 10 times without stopping. After the five questions were answered in response to the lightest weight, the next highest weight was lifted and so on. This was done for both upper body and lower body strength, for a total of 25 questions related to each. The total strength efficacy score (range 0–100%) was calculated by taking the average from all 25 questions, for both upper and lower body strength. The alpha reliability coefficients for the upper and lower body measures were in excess of 0.95.

Desire for physical strength. Following the measure of strength efficacy, participants were asked to report their level of desire or motivation to be able to lift each weight six times. The interest was not in whether participants could lift the weight six times, but rather in their motivational level to be able to lift each weight. Answers to the questions ranged from 0 to 4, "no desire whatsoever" to "very strong desire." The total score for both the upper and lower body measures was calculated by taking the average of the scores from the five different weights. Alpha reliability coefficients for these measures were 0.91 and 0.88, respectively.

Leg extension strength. After participants completed the strength efficacy and desire for strength questionnaires, they participated in a test of lower leg strength. The weight used in the test was based on each participant's score on the strength efficacy measure; specifically, participants were asked to lift the weight for which they were moderately confident that they could lift 10 times. Participants lifted the weight as many times as possible without stopping. A strength score was then computed by multiplying the weight in pounds by the number of repetitions completed. The correlation between pre- and posttraining values was r = 0.88, indicating that this measure was reliable.

Procedures

Procedures were approved by the university's institutional review board. Participants reported to the laboratory for baseline assessments. Informed consent forms were read and signed by all participants and they completed the Physical Activity Readiness Questionnaire (PAR-Q). If there were no medical conditions of concern, the subjects completed a short demographic questionnaire assessing age, gender, ethnic background, education, occupation, and any diseases or medical conditions. Participants then completed lower leg strength testing as well as questionnaires that assessed self-efficacy and desire related to upper and lower body strength. Following completion of baseline testing, participants were randomized into one of two groups: TST or PEI.

The PEI and TST groups were completely separated during training. In addition, each treatment group was divided into two sections in order to allow closer supervision by the exercise leaders. Each day began with a warm-up consisting of several laps of walking around the track followed by a brief stretching routine. The goal of the training program was to perform 8–12 repetitions of each exercise at a weight that created fatigued by the last repetition.

TST Program

The 6-wk strength-training regimen consisted of two center-based training sessions and one home-based session per week. During the supervised training days, exercises were performed using both free weights and Nautilus machines. Training involved two sets of the following 12 exercises: chest press, seated row, bent-over row, overhead press, lateral side raise, bicep curl, triceps extension; leg extension, leg curl, leg press, and calf raises. The exercises prescribed for the home-based program were essentially the same as the center-based program except that the routine was performed using dumbbells and Therabands that were provided to participants. Interactions between the exercise leaders and participants during the traditional treatment arm focused primarily on instruction and supervision of proper methods of training. Specifically, features of the traditional training condition included: (a) giving general feedback (i.e., "That is correct" or "That was fine"); (b) making comments to the group as opposed to any single individual ("You are all doing better"); and (c) focusing on corrective feedback and instruction ("Don't put your elbows down" or "Try to not do it so fast").

PEI Program

The strength-training program for PEI was the same as described for the TST arm, with the exception of the psychological empowerment component. This facet of training was delivered in two ways: through social interactions during training and through a group-mediated counseling module.

During center-based exercise sessions, participants were placed in pairs to facilitate various components of social support. More importantly, individuals this treatment arm received a great deal of specific, positive feedback on their form, effort, and ability. Based on empowerment theory (23) and self-efficacy theory (1), strategies were employed to target each participant's self-efficacy and motivation, guiding them to feel pride in their accomplishments and to be able to apply this activity to their daily lives. Specific components of the PEI condition included (a) giving frequent individual attention, (b) providing specific reinforcement for positive behaviors to each participant, (c) giving encouragement before and after each session as well as after mistakes, (d) focusing on positive comments during instruction, (e) providing specific feedback on the participant's ability and technique, (f) rewarding effort immediately, and (g) giving performance feedback and charting each participant's progress across the 6 wk of the study.

The group-mediated counseling component of the empowerment intervention was delivered in eight different meetings that followed the supervised exercise sessions beginning at the second week of training. The topics of the group sessions included (a) introductions and group rules, (b) the slippery slope of disability and sarcopenia, (c) self-awareness and self-monitoring, (d) progress and feedback, (e) focusing on accomplishments, (f) the proactive process of motivation, (g) examining changes in day-to-day living, and (h) termination of treatment. The format, order, and topics for the group counseling module were based on previous work by Rejeski (15).

Statistical Analysis

Descriptive statistics are reported as means and SD or as frequencies, partitioned by treatment group. A general linear model procedure was used to examine the changes in the outcome measures. After creating difference scores for each of the measures (found by subtracting the pretest score from the posttest score), ANCOVA were performed, covarying for pretest values of the dependent variables and gender. Effect sizes were also calculated for each measure by dividing between group differences by the pooled SD of each measure. Analyses used the 38 participants who completed the trial and excluded the four dropouts.

RESULTS

Participant demographics. Demographic and disease characteristics of the participants during the initial screening are shown in Table 1, partitioned by treatment group. The overall sample had a mean (±SD) age of 70.5 (±5.32) yr. Participants were overweight with a mean (±SD) body mass index of 26.67 (±5.40) $kg \cdot m^{-2}$. Participants were predominantly white and education levels were varied, with 11% obtaining a high school diploma and 55% earning a college degree or greater. Forty-seven percent of the sample suffered from various forms of arthritis, whereas 42% had hypertension. Randomization was effective in that there were no statistical differences between treatment groups on demographic or disease characteristics.

TABLE 1. Descriptive characteristics of participants at baseline.

Variable	Overall	Traditional Mean (SD)	Empowerment Mean (SD)
Age (yr)	70.5 (5.32)	71.3 (6.37)	69.8 (4.20)
Body mass index (kg·m^{-2})	26.67 (5.40)	27.13 (4.82)	26.26 (5.97)
Blood pressure (mm Hg)			
Systolic BP	136 (18.26)	135 (15.14)	136 (21.07)
Diastolic BP	74 (12.04)	74 (11.34)	74 (12.92)
Variable	**Overall**	**Traditional No. (%)**	**Empowerment No. (%)**
Gender			
Female	26 (68)	10 (56)	16 (80)
Male	12 (32)	8 (44)	4 (20)
Race			
White	36 (95)	18 (100)	18 (90)
African American	2 (5)	0 (0)	2 (10)
Highest level of education			
< High school graduate	2 (5)	1 (6)	1 (5)
High school graduate	4 (11)	0 (0)	4 (20)
> High school graduate	11 (29)	7 (39)	4 (20)
College graduate	7 (18)	2 (11)	5 (25)
> College graduate	14 (37)	8 (44)	6 (30)
Diseases/medical conditions			
Arthritis			
No	20 (53)	8 (44)	12 (60)
Yes	18 (47)	10 (56)	8 (40)
Hypertension			
No	22 (58)	10 (56)	12 (60)
Yes	16 (42)	8 (44)	8 (40)
Heart disease			
No	35 (92)	15 (83)	20 (100)
Yes	3 (8)	3 (17)	0 (0)
Cancer			
No	34 (90)	15 (83)	19 (95)
Yes	4 (10)	3 (17)	1 (5)
Diabetes			
No	34 (90)	17 (94)	17 (85)
Yes	4 (10)	1 (6)	3 (15)
Other			
No	34 (90)	18 (100)	16 (80)
Yes	4 (10)	0 (0)	4 (20)

As a manipulation check, we examined changes in lower leg extension performance across time. Both treatment groups made significant improvements in this outcome as a result of the 6-wk training regimen: means (±SE) = 324.98 (±59.83) for the PEI group and 228.44 (±63.31) for the TST group ($P < 0.01$). Although there was a trend for group differences in lower leg strength, these means were not statistically different from another (Table 2). Attendance in both treatment groups was above 85%.

Desire and strength efficacy. Consistent with hypotheses, the ANCOVA conducted on difference scores, covarying for pretest values for the dependent variable and gender, revealed a statistically significant difference between groups in the desire for upper body strength (F (1,33) = 5.699, P = 0.023, ES = 0.79). Inspection of change scores and SE (Table 3) revealed that the PEI group experienced more favorable change in the desire for upper body strength (mean adjusted change (Δ) = 0.71, SE = 0.12) compared to the TST group (mean adjusted Δ = 0.27, SE = 0.13). However, there were no group differences associated with change in desire for lower body strength.

As can be seen from Table 4, participants reported increases in self-efficacy for strength following the strength-training program. Interestingly, the self-efficacy data parallel the changes in desire. Participants in the PEI group reported larger upper body strength efficacy gains, with a mean adjusted change (±SE) of 25.70 (±3.02), compared with a mean adjusted change of 17.18 (±3.19) in the TST group. Additionally, the PEI group reported larger gains in lower body strength efficacy than the TST group, with a mean adjusted change (±SE) of 12.09 (±3.70) compared with 4.26 (±3.90). However, neither the between-group mean differences for the change in upper body strength efficacy (F(1,34) = 3.637, P = 0.065, ES = 0.63) nor in lower body strength efficacy (F(1,34) = 2.047, P = 0.162, ES = 0.47) were statistically different from one another. Despite the lack of statistical significance, the means were in the expected direction and the ES were moderate.

TABLE 2. Descriptive statistics for leg extension strength.

Treatment Group	Pre Mean (SD)	Post Mean (SD)	Adj. Δ Mean (SE)
TST	775.22 (420.22)	1087.29 (617.06)	228.44 (63.31)
PEI	669.21 (295.77)	961.65 (279.61)	324.98 (59.83)

Adjusted difference scores (Adj. Δ) are calculated as the amount of change from pre- to posttest, controlling for pretest values.

DISCUSSION

The purpose of this study was to evaluate the benefits of adding a psychological empowerment intervention (23) to traditional strength training on social cognitive motivational

TABLE 3. Desire for physical strength.

Variable	Traditional Mean (SE)			Empowerment Mean (SE)		
	Pre	Post	Adj. Δ	Pre	Post	Adj. Δ
Upper body desire for strength	2.95 (0.24)	3.31 (0.15)	0.27 (0.13)	3.13 (0.21)	3.76 (0.11)	0.71 (0.12)
Lower body desire for strength	3.16 (0.19)	3.47 (0.17)	0.28 (0.18)	3.22 (0.22)	3.52 (0.22)	0.33 (0.17)

Adjusted difference scores (Adj. Δ) are calculated as the amount of change from pre- to posttest, controlling for pretest values and gender.

variables in community-dwelling older adults. One of the underlying assumptions of the psychological empowerment intervention was that older individuals often need encouragement in finding a sense of control over their lives and in realizing the strengths and competencies that they possess (1,13). In the current study, the process of empowerment (23) was used in concert with constructs in social learning theory (2,3), attempting to strengthen self-efficacy expectations and the desire for physical strength. This was done through social interactions during training as well as through group-mediated behavioral sessions.

The results of this investigation partially support the hypothesis that a strength-training program (TST) supplemented by a psychological empowerment intervention (PEI) can enhance one's desire for strength and self-efficacy as compared to a strength-training program alone. Although participants in both groups reported significant increases in the desire for physical strength of the upper body, the PEI group reported significantly greater changes than the TST group. Interestingly, there were no group differences in the desire for lower body strength. Similarly, increases in self-efficacy for upper and lower body strength were in the expected direction in favor of the PEI, yet failed to reach conventional levels of statistical significance.

Desire. Although it has been traditionally recognized (3,18) that incentives can play an important role in determining one's behavior, little research has been conducted on the effects of physical activity interventions on one's level of desire for physical competence or strength (see article by Rejeski et al. in this issue). The results of the present study suggest that the PEI helped participants realize the value of their upper body strength in dealing with basic, yet important, everyday activities (e.g., carrying bags of groceries, vacuuming, pushing a lawnmower).

As noted, however, although significant group differences were observed in change in desire for upper body strength, no significant differences were found for change in desire for lower body strength. The reason for this observed difference may lie in (a) the degree to which older adults detect changes in their upper body muscles and (b) the saliency of upper body strength to older adults. The biceps is a smaller muscle than the quadriceps and the action of this muscle is more visible during training than the quadriceps. As participants in the PEI group were encouraged to observe changes in their functioning resulting from strength training, they may have been more likely to notice their improved upper body strength and functioning on salient everyday activities (e.g., lifting or carrying objects). These perceived changes may serve as reinforcement for their desire for strength. Clearly, future research should investigate what leads the older adult to perceive change in muscular strength. Psychological empowerment might be enhanced even further by providing more specific feedback on change in strength and/or by having older adults wear clothing that allows them to directly observe the action of muscles being trained.

Self-efficacy. Numerous studies have demonstrated the positive effects of resistance training on self-efficacy (5,7,20,21). As expected, the current study found that self-efficacy for strength increased for both treatment groups as a result of strength training. Furthermore, although the expected differences between groups were not statistically significant, they trended in the hypothesized direction and resulted in moderate effect sizes (between group differences in self-efficacy for upper body strength = 0.63). These trends are consistent with other studies that have used more socially enriched exercise environments to enhance self-efficacy (11,22).

We are cognizant of a number of methodological limitations in the design of the present study. First, the small sample size reduced statistical power and may have precluded the detection of statistically significant findings. Second, the length of the program may have restricted the magnitude of the treatment effects. Finally, although we were able to demonstrate that the participants in both groups experienced improved muscular performance over time, the measure did not provide the sensitivity needed to adequately test for treatment group differences in strength. Future research is needed that examines whether self-efficacy, desire, or changes in these constructs predict improvements in muscular strength and/or endurance.

Taken together, the findings of the present study imply that strength-training programs for older adults should include strategies to enhance psychological empowerment. This empowering process may be particularly important in prescribing physical activity for older adults at risk for disability. Older adults often need extra guidance and motivation in developing self-regulatory skills, which are nec-

TABLE 4. Self-efficacy for physical strength.

Variable	Traditional Mean (SE)			Empowerment Mean (SE)		
	Pre	Post	Adj. Δ	Pre	Post	Adj. Δ
Upper body strength efficacy	68.38 (5.13)	84.49 (3.96)	17.18 (3.19)	64.64 (5.61)	91.30 (2.72)	25.70 (3.02)
Lower body strength efficacy	79.98 (4.93)	83.96 (4.91)	4.26 (3.90)	78.32 (5.03)	90.66 (2.79)	12.09 (3.70)

Adjusted difference scores (Adj. Δ) are calculated as the amount of change from pre- to posttest, controlling for pretest values and gender.

essary to more effectively link their improved function to their daily activities (16). To the extent that desire for physical competence and self-efficacy related to strength influence behavior, this innovative approach may hold great promise for increasing physical activity and, ultimately, decreasing the risk of sarcopenia and disability in older adults. Additional research is needed to determine whether changes in self-efficacy and desire influence improvements in strength and/or physical function as well as long-term maintenance of strength training.

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