Exercise—It's Never Too Late: The Strong-for-Life Program

ABSTRACT

Objectives. This investigation determined whether an in-home resistance training program achieved health benefits in older adults with disabilities.

Methods. A randomized controlled trial compared the effects of assigning 215 older persons to either a home-based resistance exercise training group or a waiting list control group. Assessments were conducted at baseline and at 3 and 6 months following randomization. The program consisted of videotaped exercise routines performed with elastic bands of varying thickness.

Results. High rates of exercise adherence were achieved, with 89% of the recommended exercise sessions performed over 6 months. Relative to controls, subjects who participated in the program achieved statistically significant lower extremity strength improvements of 6% to 12%, a 20% improvement in tandem gait, and a 15% to 18% reduction in physical and overall disability at the 6-month follow-up. No adverse health effects were encountered.

Conclusions. These findings provide important evidence that home-based resistance exercise programs designed for older persons with disabilities hold promise as an effective public health strategy. (*Am J Public Health.* 1999;89:66–72)

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Although the physiologic and functional benefits of exercise by older adults have been substantiated,[1–12] national and regional surveys reveal that 70% or more of older adults do not engage in regular exercise.[13,14] With the aging of the US population, sedentary physical activity levels among older adults present a major threat to the public's health and have begun to attract national attention.[15,16]

Most previous research regarding exercise training in older persons has been conducted in supervised group programs in which adherence to specific training protocols could be highly controlled. While such studies have yielded important insights into the efficacy of exercise training in late life, they offer less insight regarding feasible and effective public health approaches to reversing the epidemic of physical inactivity among the older population.

If regular exercise is to be widely adopted and maintained by large numbers of older persons, it must be enjoyable, inexpensive, and achievable with minimal levels of professional supervision. Home exercise programs allow an individual to exercise privately, at his or her convenience, in the comfort of familiar surroundings and without having to travel, thus reducing some of the barriers to maintaining more physically active lifestyles.[17,18] A home-based approach is particularly attractive for older adults with disabilities, for whom facility accessibility, psychological barriers, and transportation are key obstacles to regular exercise.[19–21]

The existing evidence on the effectiveness of home exercise programs is mixed. While some home-based exercise programs have achieved promising physiological, psychological, and functional benefits in middle-aged adults,[17,18,22] others have demonstrated either no or only modest health benefits when implemented in older adult samples.[10,22–26] Poor adherence to specific training protocols has been implicated as a major shortcoming of home-based exercise approaches for older persons.[10,22,23]

The Strong-for-Life program was specifically developed for sedentary older adults with some degree of physical disability. The program incorporated cognitive and behavioral strategies designed to maximize participation and adherence, building on the theoretical work of Lachman and colleagues.[10,27]

Methods

Design

This study, a randomized, controlled trial among older persons with some physical disability, compared the effects of assignment to a home-based resistance exercise training group and assignment to a waiting list control group. The main hypotheses were that the Strong-for-Life program would be effective in improving participants' strength, balance, and mobility; enhancing their well-being; and reducing disability. The study was approved by the institutional review boards of the participating institutions, and all study participants provided written informed consent.

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Subjects

Subjects were recruited from 826 older persons contacted through mailings, referrals from community agencies and professionals and senior center and senior housing sites, and self-referrals between November 1994 and June 1996. Subjects, who were initially screened by telephone, had to be 60 years of age or older and had to report limitations in at least 1 of 9 functional areas (excluding vigorous activity) listed in the Short-Form Health Survey physical function scale.[28] Volunteers were excluded if they reported a medical history that contained current treatment for cancer, kidney disease requiring dialysis, a recent fracture, uncontrolled diabetes or seizures, regular use of a wheelchair, current rehabilitation care, current fainting or dizzy spells, sudden loss of coordination, or legal blindness. They were also excluded if their physician identified contraindications for exercise. Eligible volunteers received a home visit from a physical therapist who obtained written informed consent and performed a final screening and baseline assessment. After completion of the baseline data collection, subjects were randomly assigned to study groups (randomly permuted blocks of size 4) by a staff member not involved in data collection.

Of the 826 older persons contacted for this study, 21% were too ill to participate. Other reasons for exclusion included the following: nondisabled status (10%), language difficulty (4%), and reasons unrelated to the program (3%). Of the 506 eligible subjects, 215 (42%) were randomized into the study; the remainder refused to participate. Of those randomized, 202 (94%) completed all or part of the 3-month follow-up assessment, while 200 (93%) completed all or part of the 6-month assessment. Subjects who withdrew from the study did not differ on baseline characteristics from those who completed the study, nor did attrition rates differ across study groups. There were no adverse effects or accidents attributed to the exercise program.

The 107 intervention group subjects received the initial exercise training home visit by a physical therapist. The 108 control subjects were placed on a waiting list, were instructed to continue with their normal routine, and received the exercise program after the end of the study.

Intervention

Strong-for-Life consisted of a 35-minute videotaped program of 11 exercise routines performed by a trained leader. Subjects used color-coded elastic bands of varying thickness to individualize resistance.[10] The exercises included movement patterns that incorporated diagonal and rotational motions associated with functional activities. All routines were performed in a seated or standing position. Subjects were instructed to increase resistance when they could perform 10 repetitions of each movement pattern without significant fatigue or loss of proper execution. The program contained 5 minutes of warm-up, 25 minutes of strengthening, and 5 minutes of cool-down exercises. The overall adherence goal was to perform the program 3 times each week for 6 months using an agreed-upon level of resistance.

Subjects received 2 home visits conducted by a physical therapist. On the first visit, exercise technique was taught and subjects were instructed on the guidelines for progression and how to complete bimonthly exercise calendars. Each exercise calendar contained information on the frequency, level of resistance, and rating of perceived exertion.

The therapist used cognitive and behavioral strategies to enhance subjects' attitudes related to exercise and to maximize adherence to the exercise program.[27] A motivational videotape designed to address misconceptions about exercising in later life and to provide positive role models for exercise was shown and discussed during the first home visit. Individualized goal setting was implemented to tailor the program for different ability levels, and participants were asked to sign a behavioral contract for the program. Techniques of cognitive restructuring were discussed in the second home visit. The therapist taught the participants how to identify their concerns and how to generate alternatives to self-defeating thoughts that might interfere with progress. The therapist provided telephone follow-up to support and monitor progress. Participants were told to call with questions or concerns. Adherence and progression were reinforced with simple incentives. A crisp, new dollar bill was sent to the participant after each log was returned. A sticker to be placed on a Strong-for-Life ladder was sent for each 2-week period in which the exercise goal was met. With each change to a new color and thickness of elastic band, a color-coded Strong-for-Life magnet was sent.

Measurements and Procedures

All outcome data were collected by staff who were unaware of treatment assignments. Each subject received either an inexpensive videotape player installed by the project or a comparable monetary gift for participating in the study. Self-reported exercise performance data were recorded on calendars, a typical methodology used in exercise studies.[7,10,11] Subjects were instructed to record the date, the color of the elastic band used, and the perceived exertion rating for each session and to return the calendar to the therapist after each 2-week period in a self-addressed, stamped envelope.

Outcome Measures

Muscle strength. A calibrated, hand-held dynamometer (Nicholas Dynamometer, Lafayette Instruments, Lafayette, Ind) was used to assess isometric strength for the motions of shoulder flexion and abduction, elbow extension, hip abduction, and hip and knee extension. Testing was performed with the subject in a seated position (except for hip extension, where the subject stood) and the testing side shoulder at 0°, the hip flexed to 90°, and the knee flexed to 60°. Standardized protocols for joint positioning were taken from standard manual muscle testing techniques. The right leg and arm were tested unless medical conditions (e.g., pain, previous surgery or injury) prohibited using that side, in which case the left limb was tested. All joint positioning was determined with a fixed goniometer. Subjects were instructed to exert maximal effort against the tester until told to "relax." Each of the 3 trials per muscle test was held for a count of 3 seconds.

Balance. Three measures of balance were used in the study. First, the setup and protocol used for testing "functional reach" was a modified version of the test described by Duncan et al.[29] The side that was strength tested was positioned closest to the wall. Subjects were instructed to reach forward as far as possible without moving their feet, and the position of the hand before and after the reach was measured. The reach measure was the difference of these 2 measurements. Second, for the unilateral stance protocol, subjects stood with feet positioned a comfortable distance apart and arms folded against chest. Subjects were instructed to lift one foot a few inches from the floor and balance on the other leg. The weight-bearing leg was the leg that was strength tested. Subjects were instructed to balance for as long as they could or until told to stop. A maximum 30-second time limit was used. Finally, as a means of assessing tandem gait, subjects stood (without shoes) with their feet a comfortable distance apart, eyes open, and arms resting at their side. Subjects were instructed to walk heel to toe (heel of one foot touching toe of other foot) in succession. The number of successful steps was recorded until heel–toe contact was not achieved, arms were raised above 45° of abduction, or 10 steps were completed.

Functional mobility. Functional mobility was assessed with the timed "up-and-go" test.[30] A straight-backed chair with or without arms was placed 10 ft (300 cm) from a wall. The same chair selected from each subject's home was used at baseline and each follow-up. At the command "Go," the subject rose from the chair (with or without using his or her arms), walked to the wall, turned around, returned to the chair, and sat down. Assistive devices were allowed.

Two experienced physical therapists performed the in-home strength, balance, and functional ability assessments. For all tests, 1 practice trial and 2 recorded trials were performed, and the recorded trial results were averaged. The interrater reliability of these protocols was acceptable (intraclass correlations of 0.61–0.98) with the exception of knee extensor strength (intraclass correlation: 0.50) (M. M. Giorgetti et al., unpublished data, 1997).

Mood state. The Profile of Mood States Short Form was used to assess 6 different mood states.[31] This instrument contains 30 items rated on a 5-point scale ranging from not at all to extremely. Mean scores were computed across items, with higher scores indicating greater endorsement of the designated mood. Internal consistency reliabilities for the sample on 6 mood subscales were as follows: Tension-Anxiety, 0.83; Depression-Dejection, 0.84; Vigor, 0.86; Fatigue, 0.84; Anger, 0.86; and Confusion, 0.62.

Disability status. The Sickness Impact Profile 68,[32] a shortened version of the original Sickness Impact Profile 136, was used to assess disability. This instrument identified change in performance across multiple dimensions by asking subjects to choose the statements that reflected how they felt that day and how the statements related to their overall health status. Each item was assigned a weight reflecting the relative severity of limitation implied (derived from research with external judges).[33] Weights of the items were summed, and the percentage of the total possible sum was calculated; thus, each scale could range from 0 (no disability) to 100 (total disability). The total summary score and 2 subscales were used to assess disability. A physical disability subscale summarized behavior reflected in an individual's basic and instrumental functional activities and mobility (e.g., walking, climbing stairs, self-care, shopping, house cleaning). A psychological disability subscale assessed psychological autonomy, communication, social behavior, and emotional stability. Good test–retest reliability ($r = 0.90$) of the Sickness Impact Profile 68 and its subscales has been demonstrated in an older adult population.[32]

TABLE 1—Baseline Information on Subjects

	Exercise Group (n = 107)	Control Group (n = 108)
Sociodemographic background		
Age, y, mean ± SD	75.4 ± 7.4	74.6 ± 6.5
Women, %	72.9	82.4
White, %	94.4	91.7
Education, y, mean ± SD	14.2 ± 2.7	13.9 ± 3.1
Married, %	37.4	41.7
Annual income, $, %[a]		
<12 000	46.8	53.2
12 000–24 000	26.6	25.5
>24 000	26.6	21.3
Strength, kg, mean ± SD		
Hip extension	10.7 ± 4.1	10.4 ± 4.1
Hip abduction	8.5 ± 2.6	8.1 ± 2.6
Knee extension	13.8 ± 5.1	13.6 ± 4.8
Shoulder flexion	9.9 ± 4.4	9.4 ± 3.9
Shoulder abduction	9.5 ± 3.8	9.2 ± 3.3
Elbow extension	8.7 ± 2.9	8.6 ± 3.1
Function and balance, mean ± SD		
Tandem gait, steps	3.5 ± 3.4	3.6 ± 3.6
Unilateral standing, s	6.3 ± 8.2	5.1 ± 7.6
Up-and-go, s	13.7 ± 6.6	15.6 ± 14.2
Functional reach, in	9.7 ± 3.1	9.3 ± 3.4
Mood state (1–5), mean ± SD		
Depression/dejection	1.5 ± 0.7	1.5 ± 0.7
Anger	1.4 ± 0.6	1.4 ± 0.6
Tension/anxiety*	1.5 ± 0.7	1.6 ± 0.6
Confusion	1.6 ± 0.5	1.7 ± 0.6
Vigor*	2.9 ± 0.8	2.6 ± 0.8
Fatigue*	1.8 ± 0.7	2.0 ± 0.8
Sickness Impact Profile (0–100), mean ± SD		
Overall	9.6 ± 10.9	10.9 ± 12.1
Physical disability	9.2 ± 10.3	10.6 ± 12.0
Psychological disability	10.4 ± 15.2	11.5 ± 14.9

[a]n = 94.
*$P < .05$.

Statistical Analysis

The treatment groups were compared with respect to baseline age, education, strength, and balance via *t* tests. They were compared with respect to baseline mobility (the up-and-go test), mood, and disability scores via the Wilcoxon rank sum test, since these measures were skewed. Chi-square tests were used in comparing groups with respect to the discrete variables.

The effect of the exercise intervention was evaluated with repeated measures analysis.[34] The resulting coefficients were used to estimate adjusted means for baseline values and adjusted change scores in the 2 treatment groups. Significance levels were computed for contrasts in change scores between the treatment groups based on the repeated measures model. Percentage differences between the groups were calculated by subtracting the adjusted change score of the control group from the adjusted change score of the exercise group and dividing that difference by the adjusted baseline value of the exercise group. As a result of the skewness of the Sickness Impact Profile scales, these outcomes were transformed as follows: zero scores (no disability) were replaced by one half the minimum positive score for that scale at any of the 3 time points, and then the natural logarithm of each score was taken. The repeated measures models were fit for these transformed variables. Covariates that were nonsignificant in preliminary analyses for a given class of variables were eliminated to achieve more parsimonious models. The 4 outlier subjects with a timed up-and-go score above 45 seconds were eliminated from all up-and-go analyses except for the baseline comparison of the 2 treatment groups (see Table 1). All models were checked for extremely influential subjects; these individuals were eliminated, and the corresponding models were refit. To assess whether the effects of the intervention were similar among weak and strong subjects, we refit the strength models separately for subjects with baseline values at or below the median baseline

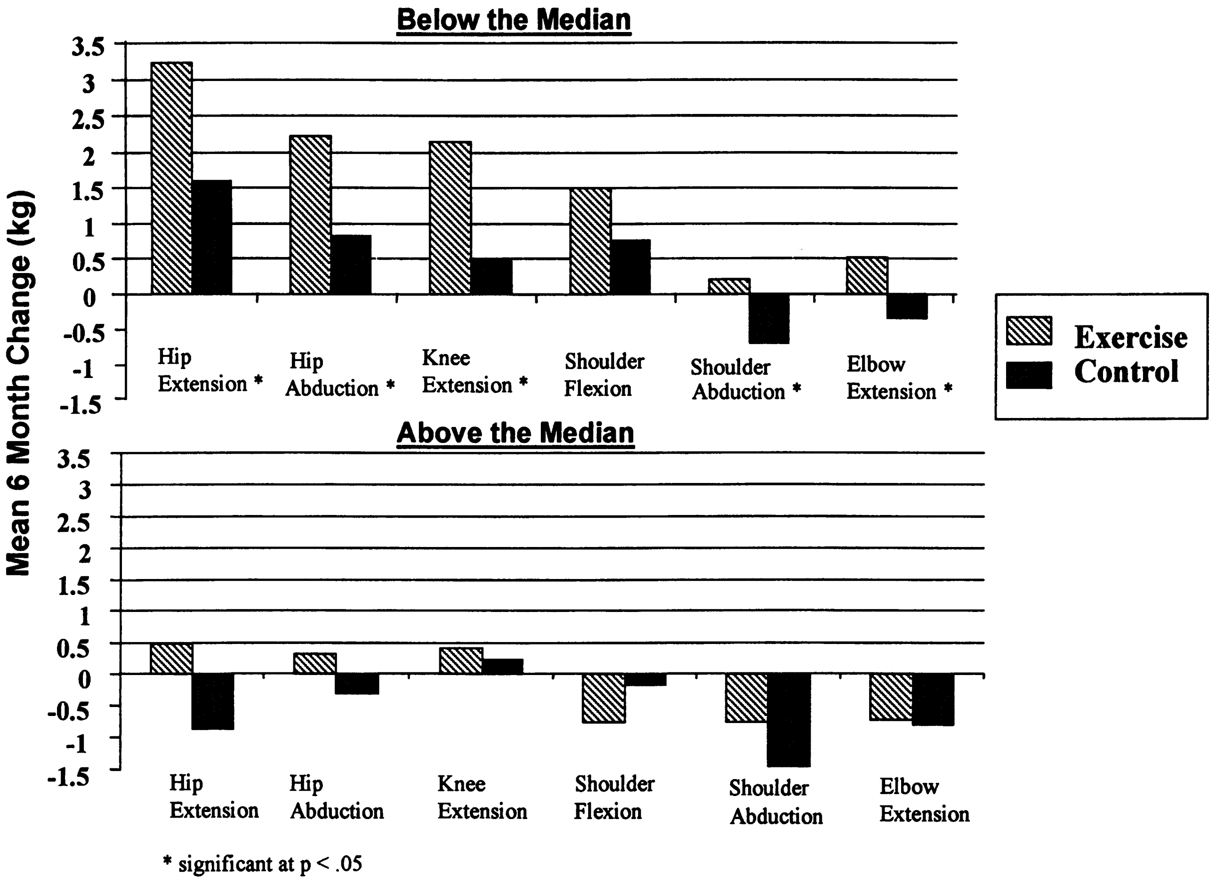

FIGURE 1—Change in strength in older adults at 6 months, by baseline values: the Strong-for-Life program, 1996.

value and subjects with baseline values above the median.

Results

Table 1 presents the baseline characteristics of the sample by study group. The sample represented a range of disability: 56% of the participants reported some limitation in 3 or more areas; 25%, in 2 areas; and 19%, in 1 area on the Short-Form Health Survey. There were no statistically significant differences between the exercise and control groups in terms of background characteristics, baseline strength, balance, mobility, depression, anger, confusion, or disability status (as measured by the Short-Form Health Survey and the Sickness Impact Profile). The exercise group had significantly better baseline values on tension, vigor, and fatigue than the control group.

Subjects assigned to the exercise intervention arm received, on average, 7 or 8 telephone contacts with the trainer during the course of the 6-month exercise period. Overall, subjects adhered to 89% of the recommended exercise sessions over the 6-month period. Fifty-seven percent of the subjects had adherence rates of 100%, and 73% of the sample exercised during 90% or more of the recommended sessions.

Table 2 illustrates the repeated measures analysis results for each outcome variable at baseline, as well as 3- and 6-month changes by study group. As hypothesized, there were significant differences between exercise subjects and controls in hip extensor, hip abduction, and shoulder abduction at the 6-month follow-up, along with borderline significant differences in knee extension. Lower extremity strength improvements for the treatment group relative to controls ranged from 6% to 12%. As Figure 1 displays, subjects with below the median level of baseline muscle strength achieved most of the observed strength differences. In addition, statistically significant hypothesized group differences were identified in disability status, as reflected by a net 15% to 18% reduction in the study group's physical disability at 3 and 6 months and an 18% reduction in overall disability at the 6-month follow-up. Borderline statistically significant group differences in gait, as reflected in a 20% increase in tandem gait steps, were observed at the 3- and 6-month follow-ups. No statistically significant group differences were detected in psychological mood states, except for a difference in perceived vigor at 3 months in the direction opposite to our hypothesis.

Discussion

This study provides important new evidence that home-based resistance exercise programs designed specifically for sedentary older persons hold promise as an effective and feasible public health strategy for achieving physical activity–related health benefits in the growing older population. This investigation revealed statistically significant study group changes in disability at the 3- and 6-month follow-ups. Strength improvements were observed only at the 6-month follow-up and were most striking among the subjects weakest at the baseline assessment. Balance and mobility benefits were in the hypothesized direction but did not achieve statistical significance.

There are several potential reasons for the success achieved by the Strong-for-Life

TABLE 2—Comparison of Treatment Groups With Respect to Baseline Values and 3- and 6-Month Change

	Adjusted Mean (SE)					
	Baseline Value		3-Month Change		6-Month Change	
	Exercise	Control	Exercise	Control	Exercise	Control
Strength[a], kg						
Hip extension	10.41 (0.40)	10.48 (0.40)	0.69 (0.52)	–0.16 (0.52)	1.66** (0.51)	0.35 (0.49)
Hip abduction	8.36 (0.26)	8.01 (0.26)	0.38 (0.34)	0.38 (0.34)	1.15** (0.33)	0.22 (0.31)
Knee extension	13.79 (0.48)	13.63 (0.47)	0.06 (0.54)	–0.22 (0.54)	1.12* (0.53)	0.17 (0.51)
Shoulder flexion	9.62 (0.33)	9.54 (0.33)	–0.28 (0.38)	–0.10 (0.38)	0.24 (0.37)	0.25 (0.35)
Shoulder abduction	9.27 (0.29)	9.38 (0.28)	–0.92 (0.35)	–1.05 (0.35)	–0.20** (0.35)	–1.07 (0.33)
Elbow extension	8.58 (0.25)	8.59 (0.24)	–0.79 (0.32)	–0.58 (0.32)	–0.15 (0.32)	–0.50 (0.30)
Balance and function[b]						
Tandem gait (0–10 steps)	3.59 (0.33)	3.54 (0.33)	1.24* (0.41)	0.43 (0.41)	1.22* (0.40)	0.48 (0.38)
Unilateral stand (0–30 s)	6.55 (0.74)	4.96 (0.74)	1.68 (0.77)	1.83 (0.77)	1.22 (0.75)	1.53 (0.72)
Up-and-go, s	13.39 (0.46)	13.68 (0.46)	–1.00* (0.36)	–0.32 (0.36)	–1.02 (0.35)	–0.74 (0.33)
Functional reach, in	9.76 (0.28)	9.15 (0.28)	–0.42 (0.31)	–0.09 (0.31)	–0.04 (0.31)	–0.18 (0.29)
Mood state[c]						
Depression	1.49 (0.06)	1.51 (0.06)	–0.06 (0.06)	–0.01 (0.06)	–0.06 (0.06)	–0.01 (0.06)
Anger	1.38 (0.06)	1.41 (0.06)	0.04 (0.05)	0.01 (0.05)	–0.04 (0.05)	0.01 (0.05)
Tension	1.50 (0.06)	1.59 (0.06)	0.05 (0.06)	0.04 (0.06)	0.01 (0.06)	–0.02 (0.06)
Confusion	1.65 (0.05)	1.70 (0.05)	0.01 (0.05)	0.00 (0.05)	0.01 (0.05)	0.02 (0.05)
Vigor	2.88** (0.09)	2.56 (0.09)	–0.10** (0.08)	0.17 (0.08)	–0.11 (0.09)	0.04 (0.08)
Fatigue	1.83 (0.08)	2.01 (0.07)	0.05 (0.08)	–0.04 (0.08)	0.13 (0.08)	–0.03 (0.08)
Disability[d]						
ln(overall disability) (range: –1.04 to 4.10)	1.52 (0.15)	1.66 (0.15)	–0.43 (0.10)	–0.24 (0.10)	–0.55** (0.10)	–0.27 (0.10)
ln(physical disability) (range: –0.60 to 4.03)	1.53 (0.14)	1.62 (0.14)	–0.47** (0.09)	–0.19 (0.09)	–0.45* (0.09)	–0.21 (0.09)
ln(psychological disability) (range: –0.08 to 4.43)	1.50 (0.13)	1.67 (0.13)	–0.09 (0.11)	–0.15 (0.11)	–0.31 (0.11)	–0.15 (0.10)

Note. Strength models are adjusted for gender, age, height, weight, and assessor. Balance models are adjusted for age and assessor. Mood state models are adjusted for gender. Disability models are adjusted for gender and age.
[a]Higher values better.
[b]Higher values better except for up-and-go.
[c]1–5 scale; lower numbers better except for vigor.
[d]Lower numbers better.

program. First, through the use of cognitive and behavioral strategies, along with exercise instruction, high levels of participation and adherence to training protocols were achieved, overcoming a concern noted in previous home-based exercise studies.[10,11,23,24] Although the success cannot be attributed definitively to the cognitive and behavioral strategies, a recent study that used the Strong-for-Life program in older adults without any cognitive/behavioral techniques achieved a 3-month participation rate of only 58% (vs 89% in this study) over 6 months.[10] The telephone monitoring and behavioral incentives used in this study with older adults are consistent with approaches used successfully in studies with middle-aged samples.[18,22] Phone contact is a time-efficient and effective method of monitoring involvement in a home-based exercise program. The use of a motivational videotape as part of the exercise training may also have contributed to the high participation rate by providing a perception of social contact that may have complemented the periodic contact by the monitoring therapist.

It should be noted that the muscle strengthening (6% to 12% net increase) and disability (15% to 18%) effects, while modest relative to results achieved by group exercise programs with older subjects,[35–38] were of greater magnitude than in previous home-based exercise studies with older subjects.[10,11,23,24] Ettinger,[11] for example, in a recent study of a combination facility-based and home-based resistance training program for older persons with knee osteoarthritis (mean age = 69 years), observed a modest 8% difference in adjusted mean disability and knee flexion strength scores between a resistance training and health education control group at 18 months postrandomization. Although modest at a clinical level, if physical activity–related health outcomes of the level achieved with this program could be achieved on a population scale, substantial societal health benefits could result.[39]

The modest magnitudes of the muscle strengthening effects may have been due to the low intensity of the resistance program. The Strong-for-Life program balanced intensity of the training protocol with making the program simple, safe, and feasible for older persons to do in their home with minimal supervision. These same features, while contributing to the high levels of adherence seen in this study, may have provided a lower training stimulus and thus diminished the observed effects. Although progression in resistance was a mutually agreed-upon goal accomplished over the telephone with the therapist, the subjects may have underestimated their strength ability. This approach placed considerable initiative for increasing intensity on the subjects themselves. Although band resistance ranged from no band used to 9 different colors, subjects achieved a mean increase of only 3.4 (± 1.5) colors during the course of the study.

Another potential explanation for the modest magnitude of effects was the form of resistance used. While the use of elastic bands contributed to the ease, enjoyment, and low cost of the program, several problems were encountered with the bands that also may have diminished program effects. Exercise intensity was estimated by band color, with sequential coloring representative of increasing band thickness and, hence, degree of resistance. Unfortunately, with ongoing use, the bands tended to stretch and lengthen, thereby reducing the resistance provided. Breakage of the bands was also encountered on occasion, which required using a lower level of resistance until a replacement could be delivered to the subject. These problems may have particularly diminished the training stimulus for subjects with higher levels of baseline strength.

We had hypothesized that improvements in balance would emerge from regular use of the Strong-for-Life program, and some balance and mobility improvements achieved marginal statistical significance. These positive trends might have been secondary to the improved coordination of the limbs and trunk that usually occurs during the initial stage of exercise training.[4] The balance and mobility benefits might have been diminished since, for safety reasons, many of the exercise routines were done in a sitting position and those that were done in a standing position involved the subject holding on to a chair.

Contrary to our predictions, we did not find psychological benefits from the exercise training. There are several possible reasons for this result. Earlier work showing psychological benefits of exercise programs with the elderly primarily involved group aerobic exercise.[40,41] Moods such as depression and anxiety may be tied more to cardiovascular and pulmonary function associated with aerobic exercise than to resistance training. It is also possible that exercising in groups is key to psychological effects. In other studies, psychological change has been found primarily for those who started out with poor function (e.g., moderate or clinical levels of depression). At baseline, our sample had relatively high levels of psychological well-being, attenuating the opportunity for observing psychological change.

One of the attractive features of the Strong-for-Life design is its cost. The component expenses were relatively modest, consisting of the costs of the videotape, the resistance bands, and initial consultation with a physical therapist. There were no major injuries related to the exercise program, only minor musculoskeletal discomfort. A related cost, of course, would be the purchase of a videotape player if one were not already available to an older person. Access to a videotape player, however, is becoming increasingly common in the older population. Resistance training in a sample with disability, however, does require modifications that accommodate an individual's physical limitations. In this study, exercise modifications were made in 50% of subjects, almost all of them secondary to musculoskeletal complaints.

In summary, our findings demonstrate that the Strong-for-Life home-based resistance training program is a safe, low-cost, effective method for increasing physical activity among older persons with disabilities. Home-based resistance exercise programs designed specifically for older persons hold promise as a feasible and effective public health strategy for achieving physical activity–related health benefits in the growing older population. □

Contributors

Dr Jette, Dr Lachman, and Ms Harris coconceived and codeveloped the Strong-for-Life study and this paper. Dr Jette wrote the first draft of the paper and coordinated all revisions, directed the analysis, and produced the final version. Dr Assmann conducted the statistical analyses and wrote the first draft of the analysis section. Ms Levenson and Ms Wernick wrote the section on measurement protocols. Ms Giorgetti wrote the first draft describing the Strong-for-Life intervention. Dr Jette, Dr Assmann, Dr Krebs, Dr Lachman, and Ms Harris contributed to the interpretation and discussion of the results. All the authors contributed to earlier drafts of the paper, provided revisions, and approved the final version. All authors are guarantors of the integrity of the article.

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Copies of the Strong-for-Life videotape (running time: 38:35) can be purchased from Baxley Media Group, 110 West Main, Urbana, IL 61801, (800) 421-6999. The motivational videotape, *Exercise: It's Never Too Late* (running time: 15:00), can be purchased from Films for the Humanities and Sciences, PO Box 2053, Princeton, NJ 08543, (800) 257-5126.

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