

Functional-Task Exercise Versus Resistance Strength Exercise to Improve Daily Function in Older Women: A Randomized, Controlled Trial

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OBJECTIVES: To determine whether a functional-task exercise program and a resistance exercise program have different effects on the ability of community-living older people to perform daily tasks.

DESIGN: A randomized, controlled, single-blind trial.

SETTING: Community leisure center in Utrecht, the Netherlands.

PARTICIPANTS: Ninety-eight healthy women aged 70 and older were randomly assigned to the functional-task exercise program (function group, $n = 33$), a resistance exercise program (resistance group, $n = 34$), or a control group ($n = 31$). Participants attended exercise classes three times a week for 12 weeks.

MEASUREMENTS: Functional task performance (Assessment of Daily Activity Performance (ADAP)), isometric knee extensor strength (IKES), handgrip strength, isometric elbow flexor strength (IEFS), and leg extension power were measured at baseline, at the end of training (at 3 months), and 6 months after the end of training (at 9 months).

RESULTS: The ADAP total score of the function group (mean change 6.8, 95% confidence interval (CI) = 5.2–8.4) increased significantly more than that of the resistance group (3.2, 95% CI = 1.3–5.0; $P = .007$) or the control group (0.3, 95% CI = –1.3–1.9; $P < .001$). Moreover, the ADAP total score of the resistance group did not change significantly compared with that of the control group. In contrast, IKES and IEFS increased significantly in the resistance group (12.5%, 95% CI = 3.8–21.3 and 8.6%, 95% CI = 3.1–14.1, respectively) compared with the func-

tion group (–2.1%, 95% CI = –5.4–1.3; $P = .003$ and 0.3%, 95% CI = –3.6–4.2; $P = .03$, respectively) and the control group (–2.7%, 95% CI = –8.6–3.2, $P = .003$ and 0.6%, 95% CI = –3.4–4.6; $P = .04$, respectively). Six months after the end of training, the increase in ADAP scores was sustained in the function group ($P = .002$).

CONCLUSION: Functional-task exercises are more effective than resistance exercises at improving functional task performance in healthy elderly women and may have an important role in helping them maintain an independent lifestyle. *J Am Geriatr Soc* 53:2–10, 2005.

Key words: exercise; elderly; physical function; muscle strength

A sedentary lifestyle is considered to be one of the most important factors contributing to loss of independent performance of daily tasks.^{1–3} Many randomized trials have demonstrated the positive effect of regular exercise on older people's muscle strength, flexibility, aerobic capacity, and balance^{3–7} and on reducing the risk of falls and fractures and preventing (coronary) disease,^{5,6} but the effect of currently available exercise programs on the performance of daily tasks remains unclear.^{3,7} Moreover, the diversity of programs available makes it difficult to determine which type of exercise has the most effect on the performance of daily tasks.^{3,7,8}

Resistance strength training is the type of exercise most frequently tested in trials involving older adults,⁷ but improved muscle strength does not consistently result in improved functional task performance.^{7,9,10} Although several exercise studies have focused on selected intermediate outcome measures, such as muscle strength, balance, and gait analysis,^{5,11,12} it has not been demonstrated that an increase in these outcome measures automatically results in improved performance of daily tasks.

Furthermore, several studies have reported that the muscle strength gain induced by resistance programs is lost

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after a short detraining period.¹³ When physical exercise is stopped (detraining), the body adjusts to the diminished physiological demand, and the beneficial adaptations may be lost.¹⁴ Because older adults are more likely to interrupt an exercise program because of ill health,¹⁵ exercise programs should aim to elicit longer-lasting effects.

To improve the ability of older people to perform daily tasks, an exercise program was developed focusing on functional tasks of everyday life, tasks that are affected early in the aging process.¹⁶ In a pilot study, the new functional-task exercise program proved to be feasible and well tolerated by community-living older women.¹⁷ The aim of the present study was to determine whether the functional-task exercise program and a resistance exercise program have different training and detraining effects on the ability of community-living older people to perform daily tasks, as measured using the Assessment of Daily Activity Performance (ADAP).

METHODS

Design and Participants

Community-dwelling women aged 70 and older were recruited by means of advertisements placed in the local newspaper for inclusion in a single-blind, randomized, controlled trial. The medical ethics board of the University Medical Center Utrecht in the Netherlands approved the study. Figure 1 shows the flow of participants through the trial. Of the 156 respondents, 50 were excluded after tel-

ephone interviews, during which it was determined, using a validated questionnaire, whether participants were medically fit enough to participate in an exercise program for older people.¹⁸ Exclusion criteria included recent fractures, unstable cardiovascular or metabolic diseases, musculoskeletal disease or other chronic illnesses that might limit training or testing, severe airflow obstruction, recent depression or emotional distress, or loss of mobility for more than 1 week in the previous 2 months. Respondents who exercised at a sports club three times a week or more were also excluded. Of the 106 potential participants who were screened for medical history and underwent a physical examination, eight subjects failed the examination. During the screening procedure, the physician also administered the Specific Activity Scale (SAS).¹⁹ The 98 women who met the inclusion criteria gave written informed consent and were randomly assigned by computer using a random numbers table to the new functional-task exercise program (function group, $n = 33$), the resistance exercise program (resistance group, $n = 34$), or the control group (control group, $n = 31$).

Exercise Interventions

The exercise programs were followed at a local leisure center in the Utrecht region during three periods of 12 weeks (January to March, April to June, and September to December 2001). The control group was run concurrently with the exercise groups. Exercises were performed three times a week in 1-hour sessions for 12 weeks, with sessions separated by 1 day of rest. Group size varied from six to 12 participants per session for both exercise programs. At least two experienced instructors (physiotherapist and sports teacher) supervised training sessions.

During the exercises, participants in both programs registered their exercise performance in a personal file to provide themselves and their instructors with feedback about their progress. Sessions were divided into a 10-minute warm-up period of aerobic exercises, a 40-minute core exercise period, and a 10-minute cool-down period of flexibility exercises for limbs and trunk. The core exercises were specific to the group assignment; all other components were consistent across groups. The warm-up and cool-down periods were undertaken as group activities and accompanied by music. The core exercises of both programs were performed in training pairs (dyad training),²⁰ with emphasis on interaction and enjoyment. Training partners took turns between observational and physical practice (dyad alternate). Exercise intensity in both exercise programs was set at 7 to 8 on a 10-point rating scale perceived exertion scale (1 = very, very light; 10 = very, very hard).²¹ Several studies have demonstrated that these ratings of perceived exertion scales can validly provide information regarding the intensity of resistance exercise.^{21–23} Participants in the function group were instructed to increase the weight carried, the number of repetitions, or the distance walked if an exercise was rated only “somewhat hard.” Resistance could also be increased by putting on a weighted vest (1–10 kg) during the tasks. Participants in the resistance group were instructed to increase the load if an exercise was rated only “somewhat hard.”

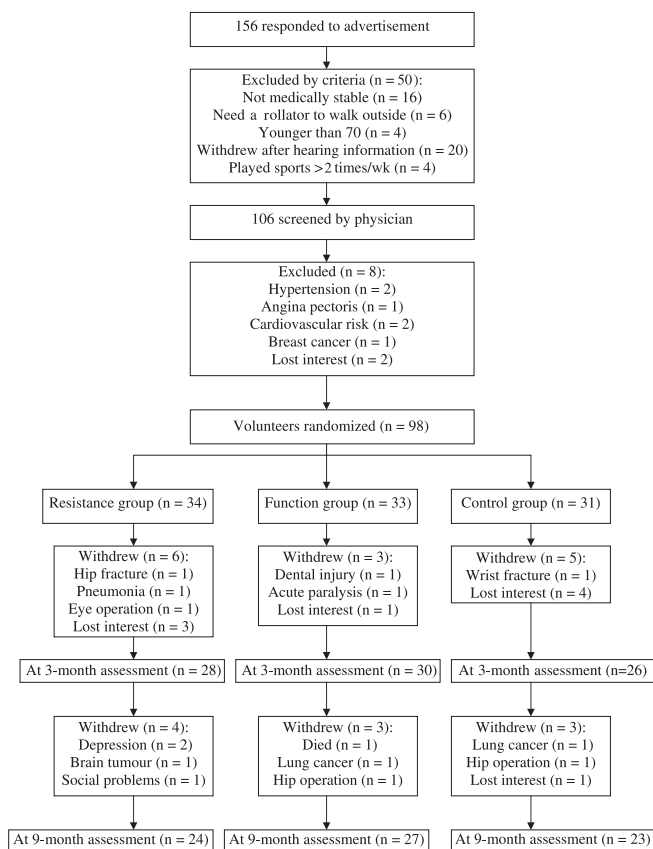


Figure 1. Trial profile.

Functional-Task Exercise Program

The aim of the 40-minute core exercises was to improve daily tasks in the domains first affected in older adults,¹⁶ namely, moving with a vertical component, moving with a horizontal component, carrying an object, and changing between lying-sitting-standing position (detailed exercise protocol available from the authors). During each exercise class, participants performed tasks for at least two of these domains in three sessions of five to 10 repetitions. The 12-week program was divided into a practice phase (2 weeks), a variation phase (4 weeks), and a daily tasks phase (6 weeks).

Exercises in the practice phase consisted of short, simple tasks. The weight transported and repetitions were noted. In the variation phase, participants applied these basic tasks in various training conditions, such as environment, attributes, and interaction between participants. Trainers registered the time it took to complete a task in this phase. Participants were encouraged to perform the tasks as quickly as possible and to increase the weight carried, the number of repetitions, and the distance walked. The daily tasks phase consisted of a combination of the four domains, to make the tasks as similar to daily tasks as possible. Again, time, weight, distance walked, and number of repetitions were noted.

During each phase, the instructors could complicate or simplify motor, environment, and cognitive aspects of the tasks depending on the participant's ability. Each aspect could be changed in a stable and a variable way. For instance, during the task "rise from a chair, step onto a raised platform (20 cm), and take different objects from a high shelf" from the daily tasks phase, the motor aspects could be altered by collecting more objects (stable) or carrying the objects in different manners (variable). The environment could be adapted by changing the height of the raised platform (stable) or by letting two participants of different training pairs step together onto one raised platform (variable). The cognitive aspects could be altered by collecting the objects in a certain combination (e.g., by color) (stable) or by letting two participants collect the objects in a certain combination (e.g., if one person takes a green object, the next person has to collect a red object) (variable). Detailed description of the exercises used can be obtained from the authors.

Resistance Exercise Program

The core resistance exercises were designed according to the American College of Sports Medicine recommendations for exercise and physical activity for older adults⁶ and based on the exercises of the Fit for Your Life resistance training program.²⁴ The aim of the exercises was to strengthen the muscle groups that are important for daily task performance, namely, elbow flexors and extensors; shoulder abductors, adductors, and rotators; trunk flexors and extensors; hip flexors, extensors, abductors, and adductors; knee flexors and extensors; and ankle dorsal and plantar flexors. In a typical progressive resistance protocol, three to four muscle groups were trained in three sets of 10 repetitions. Dumbbells (0.5–8 kg) and elastic tubing (three resistances of elastic bands) were used for resistance during elbow, shoulder, and trunk exercises. Ankle weights (0.25–10 kg) were used for resistance during hip and knee exer-

cises. To strengthen ankle plantar flexors, body weight was used for resistance by raising the body up as high as possible on the toes. Participants alternated upper and lower body exercises to prevent overuse injuries, with approximately 2 minutes of rest allowed between sets. If an exercise was rated only "somewhat hard," the participants were instructed to increase the load by using heavier dumbbells, by putting more weight in the ankle weights, or by using an elastic band with a higher resistance level. The elastic bands could also be shortened for more resistance. The number of repetitions and the resistance level of each set were registered in participants' personal files. The exact set of exercises used can be obtained from the authors.

Control Group

The nonexercising subjects of the control group were asked to keep to their normal pattern of activity during the 3-month intervention period.

MEASUREMENTS

An experienced examiner who was blinded to the training conditions performed assessments at baseline, after the 3-month intervention period, and after a 6-month detraining period (at 9 months) at the Mobility Laboratory of the Department of Geriatric Medicine at the University Medical Center Utrecht. At the beginning of the assessments, participants were specifically instructed not to reveal the type of exercise program followed. To verify the blinding status, the examiner filled out a form at the end of the 3-month measurements stating whether the participant had revealed her treatment status. The examiner was also asked to estimate the treatment status of the participant (function, resistance, or control). Physical functional performance was measured using the ADAP and the Timed Up and Go (TUG). Muscle function tests included isometric knee extensor strength (IKES), isometric elbow flexor strength (IEFS), handgrip strength (HGS), and leg extension power (LEP).

Preliminary investigations of community-living adults demonstrated the TUG, IKES, HGS, and LEP tests to be reliable and valid.²⁵ The ADAP has been found to be a reliable instrument. In a test-retest design, the examiner of the present study tested 19 community-living, older women (mean age \pm standard deviation 73.8 ± 3.1) with a 1-week interval. The intraclass correlation coefficient (r) was 0.96 for ADAP total score and ranged from 0.75 to 0.95 for domain scores. The ADAP total score correlated significantly with the 36-item Health Survey physical component summary (PCS) scale ($r = 0.64$) and physical functioning scale ($r = 0.67$) and IKES ($r = 0.80$). The IEFS test was found reliable (intraclass correlation coefficient = 0.96) in a test-retest design with 15 older women (mean age 80.4 ± 6.5) and a 1-week interval between measurements. The IEFS correlated significantly with a fixed strain gauge (AFG-Advanced Force Gauge, Mecmesin Inc., Santa Rosa, CA) ($r = 0.78$) (unpublished results).

Physical Functional Performance

Physical functional performance was quantitatively assessed using the ADAP.¹⁷ This method, which allows the participant to perform at maximal ability by

maximizing the weight carried and working at the fastest speed possible or reaching the greatest distance, was patterned after the Continuous-scale Physical Functional Performance (Cs-PFP) test, as demonstrated to be reliable, valid, and sensitive to change in function.^{17,26,27} The Cs-PFP test was modified to Dutch dimensions for bed size (190 cm × 200 cm × 60 cm height), height of the kitchen counter (114 cm), and height of the washing machine (88.5 cm). The functional reach test replaced vertical reach.²⁸ Measurement protocols and participant instructions were standardized. For functional reach, the protocol of Duncan et al. was followed.²⁸ Like the Cs-PFP test, the ADAP includes 16 common tasks, such as transferring laundry and boarding a bus, performed at maximal effort. The ADAP provides a total score and five physical domain scores: upper body strength, lower body strength, flexibility, endurance, and balance and coordination. In general, scores on a specific task can contribute to one, two, or three domains. Tasks quantified by weight carried and time are carrying a weighted pan, pouring water from a jug into a cup, carrying weight up and down a bus platform, and carrying groceries. Tasks quantified by time alone are transferring laundry from a washer to a dryer, putting on and removing a jacket, sweeping the floor, vacuuming, making a bed, climbing stairs, getting down onto and up from the floor, pulling open a door, closing a hook-and-loop strap over the shoe, and picking up four scarves from the floor. Tasks quantified by distance are 6-minute walk and functional reach.

Each task was scaled from 0 to 100 according to the formula:

$$\text{Observed score} = (\text{Observed score} - \text{lower limits}) / (\text{upper limits} - \text{lower limits}) \times 100$$

If the observed score was less or equal to the lower limit, the score was 0. For an observed score greater than or equal to the upper limit, the score was 100. Unattempted tasks received a score of 0. Time was converted to speed (1/t) so that higher numbers reflect a better function for each of the units measured: weight, distance, and speed. The exact upper and lower limits used can be obtained from the authors.

Timed Up and Go Test

In this test, the time an individual needs to rise from a standard arm chair (seat 46 cm high), walk 3 m, turn around, return to the chair, and sit down again is measured.^{17,29,30} The test was performed three times as quickly as possible. The quickest time, recorded in seconds, was used for analysis.

Muscle Function Tests

IKES was measured in both legs using a fixed strain gauge (AFG-Advanced Force Gauge).^{17,25,31} The highest score of five attempts was recorded in newtons. IEFS was measured in both arms using a handheld dynamometer (microFET, Hoggan Health Industries, Draper, UT).^{9,17,32} The highest score of three attempts was recorded in newtons. HGS was measured using a mechanical handgrip dynamometer (Takei Kiki Kogyo 5101, Tokyo, Japan).^{9,17} The best score of five attempts was recorded in kilogram force. LEP was measured in both legs using the Nottingham power rig (NUMAS, University of Nottingham Medical Faculty

Workshops, Nottingham, UK).^{9,17,33} The measurements were repeated until no further improvement was seen, up to a maximum of 10 pushes.²⁵ The highest recorded power output was recorded in watts.

Statistical Analysis

All data were analyzed using SPSS statistical software (SPSS Inc., Chicago, IL). In a pilot study, a sample size of 30 to 35 participants per group was estimated to provide more than 80% power at a significance level of $P < .05$ to detect a difference between exercise groups of 10% to 15% in ADAP total score and IKES.

Univariate analysis of variance was used to test for differences in baseline characteristics between intervention groups and to test for differences between dropouts and participants that completed the study. SAS scores were compared between groups using the Kruskal-Wallis non-parametric test.

Peak values over the left and right legs, arms, or hands of IKES, IEFS, HGS, and LEP were averaged and used for analysis. Three-group analysis of variance with a post hoc Bonferroni correction was used to compare changes in test performance between interventions. Changes were calculated as the mean change and mean percentage change between scores at baseline and 3 months and between scores at baseline and 9 months.

RESULTS

The baseline characteristics of the participants are shown in Table 1. Mean age was 74.7 ± 3.5 (range 70–82) in the function group, 74.8 ± 4.0 (range 70–83) in the resistance group, and 73.0 ± 3.2 (range 70–84) in the control group. More than half of the participants were widowed (control group 55%, resistance group 44%, function group 58%). No significant differences between the groups were found in baseline scores for ADAP scores or muscle function. The distribution of SAS scores demonstrated that randomization was successful. The examiner guessed the correct intervention in only 37% of the cases (chi square = 0.519; $P = .47$).

Between the baseline and 3-month measurements, three participants in the function group, six in the resistance group, and five in the control group withdrew (Figure 1). After 6 months of detraining, three participants in the function group, two in the resistance group, and three in the control group dropped out (Figure 1). The baseline data for participants that withdrew did not differ from those for the 74 participants who completed the study.

Training compliance, defined as the number of exercise classes attended as a percentage of the total number of classes, was $83.0 \pm 26.6\%$ (range 0–100%) in the function group and $74 \pm 34.6\%$ (range 0–100%) in the resistance group. Without dropouts, participants in the function group attended on average $90 \pm 9.1\%$ of the exercise classes (range 66–100%), and participants in the resistance group attended on average $90 \pm 8.1\%$ of the exercise classes (range 71–100%). The following adverse events were reported and required adaptation of the personal training program in the function group: muscle pain ($n = 8$), osteoarthritic joint pain ($n = 5$), prosthetic joint pain ($n = 4$), and lower back pain ($n = 4$) and in the resistance group: muscle

Table 1. Baseline Characteristics

Characteristic	Control Group (n = 31)	Resistance Group (n = 34)	Function Group (n = 33)
Age, mean \pm SD	73.0 \pm 3.2	74.8 \pm 4.0	74.7 \pm 3.5
Marital status, %			
Married	42	50	36
Single	3	6	6
Widowed	55	44	58
Disease status, %			
Hypertension	30	28	33
Arthritis	30	28	23
Prosthetic hip/knee	4	13	20
Diabetes mellitus	4	0	3
Medication 3 or more	26	16	23
Osteoporoses	11	16	10
Height, meters, mean \pm SD	1.62 \pm 0.06	1.62 \pm 0.08	1.63 \pm 0.06
Weight, kg, mean \pm SD	71.3 \pm 11.4	70.7 \pm 12.1	69.4 \pm 9.0
Specific activity scale class, %			
1	14(45)	14(41)	14(42)
2	15(48)	19(56)	18(55)
3	2(7)	1(3)	1(3)
4	0	0	0
Assessment of daily activity performance test, mean \pm SD			
Total score	47.7 \pm 9.6	45.7 \pm 8.1	47.4 \pm 9.9
Upper body strength	50.5 \pm 11.7	49.3 \pm 6.5	50.6 \pm 9.3
Lower body strength	40.8 \pm 10.5	39.5 \pm 8.9	40.3 \pm 11.3
Flexibility	49.1 \pm 11.4	49.4 \pm 9.9	54.8 \pm 11.5
Balance and coordination	41.9 \pm 9.6	39.4 \pm 10.4	40.1 \pm 11.2
Endurance	46.6 \pm 10.0	44.4 \pm 9.7	45.7 \pm 11.0
Timed Up and Go, seconds	5.1 \pm 1.0	5.4 \pm 1.0	5.1 \pm 1.1
Muscle function, mean \pm SD			
Isometric knee extensor strength, N	306.4 \pm 77.1	282.5 \pm 90.5	307.3 \pm 79.5
Handgrip strength, kgF	22.1 \pm 3.9	21.9 \pm 4.1	21.7 \pm 3.7
Isometric elbow flexor strength, N	165.5 \pm 27.6	158.6 \pm 34.6	166.2 \pm 29.1
Leg extensor power, W	127.5 \pm 45.8	105.8 \pm 39.9	113.9 \pm 37.4

SD = standard deviation; kgF = kg force; N = newtons, W = watts.

pain (n = 10), osteoarthritic joint pain (n = 5), prosthetic joint pain (n = 3), and lower back pain (n = 4). One participant in the resistance group strained a hamstring muscle, as a result of which two exercise classes were missed and the personal training program was adapted. Despite these reported complaints, all participants completed the exercise programs.

Table 2 shows that, at the end of the 12-week training period, the function group had a higher ADAP total score and greater upper body strength, lower body strength, upper body flexibility, balance and coordination, and endurance than the control group. Changes in TUG scores did not differ between the function group and the control group. ADAP balance and coordination was better in the resistance group than in the control group, but no difference was seen for ADAP total score, upper body strength, lower body strength, upper body flexibility, endurance, or TUG.

The function group had a significantly greater increase at the end of the 12-week training period in ADAP total score, lower body strength, balance and coordination, and endurance than the resistance group. No difference in the

effect of exercise between the function group and the resistance group was found for ADAP upper body strength, upper body flexibility, or TUG.

At the end of the 12-week training program, the change in IKES, IEFS, and HGS was not significantly different between the function and control groups. LEP increased significantly more in the function group than in the control group. IKES and IEFS were increased more in the resistance group than in the control group, but no change was seen in HGS. LEP increased significantly more in the resistance group than in the control group. The resistance group had a significantly greater improvement in IKES and IEFS than the function group. Figure 2 shows the mean percentage change in strength measures after the training period. Mean percentage change in IKES and IEFS was significantly higher in the resistance group than in the control and function groups.

Nine months after baseline, the changes in ADAP total score, upper body strength, lower body strength, balance and coordination, and endurance of the control group were significantly different from those of the function group but not the resistance group (Table 3).

Table 2. Changes in Outcome Measures Between Baseline and 3-Month Measures

Measure	Control Group (n = 26)			Resistance Group (n = 28)			Function Group (n = 30)			Resistance Versus Function	
	Mean ± SD	95% CI	P-value*	Mean ± SD	95% CI	P-value†	Mean ± SD	95% CI	P-value‡	P-value†	P-value‡
Assessment of daily activity performance											
Total	0.3 ± 3.8	-1.3-1.9	.69	3.2 ± 4.8	1.3-5.0	.06	6.8 ± 4.3	5.2-8.4	<.001		.007
Upper body strength	1.3 ± 3.4	-0.2-2.7	.08	1.9 ± 4.7	0.1-3.7	1.00	4.3 ± 4.9	2.4-6.1	.05		.15
Lower body strength	1.9 ± 3.0	0.6-3.1	.005	2.9 ± 4.8	1.0-4.7	1.00	7.4 ± 4.9	5.5-9.2	<.001		.001
Upper body flexibility	-3.0 ± 5.9	-5.4 to -0.6	.02	1.9 ± 10.2	-2.1-5.9	.14	7.4 ± 9.5	3.8-11.0	<.001		.07
Balance and coordination	0.4 ± 5.7	-2.0-2.7	.74	4.6 ± 6.0	2.2-6.9	.05	8.7 ± 6.6	6.2-11.2	<.001		.04
Endurance	-0.1 ± 5.1	-2.2-2.1	.95	3.3 ± 5.7	1.1-5.5	.09	8.0 ± 5.7	5.8-10.1	<.001		.005
TUG, seconds	0.1 ± 0.7	-0.2-0.4	.45	-0.1 ± 0.7	-0.3-0.2	1.00	-0.1 ± 0.7	-0.3-0.2	.84		1.00
Isometric knee extensor strength, N	-8.2 ± 37.1	-23.5-7.1	.28	23.7 ± 30.1	12.0-35.3	.001	-7.0 ± 25.2	-16.6-2.6	1.00		.001
Handgrip strength, kgF	-0.3 ± 2.0	-1.1-0.5	.48	-0.2 ± 1.5	-0.8-0.4	1.00	-0.1 ± 1.5	-0.6-0.5	1.00		1.00
Isometric elbow flexor strength, N	0.0 ± 14.6	-6.0-6.1	1.00	10.6 ± 16.0	4.4-16.8	.06	-1.0 ± 17.4	-7.6-5.7	1.00		.03
Leg extensor power, W	-7.0 ± 26.1	-17.8-3.8	.19	10.8 ± 25.8	0.6-21.0	.05	11.2 ± 27.5	0.7-21.6	.04		1.000

Note: Positive change scores indicate improvement, except for Timed Up and Go (TUG) scores.

* T test mean change between baseline and 3-month scores control group.

† Analysis of variance (ANOVA) with a Bonferroni correction for comparison between exercise group and control group.

‡ ANOVA with a Bonferroni correction for comparison between resistance group and function group.

SD = standard deviation; CI = confidence interval; N = newtons; W = watts.

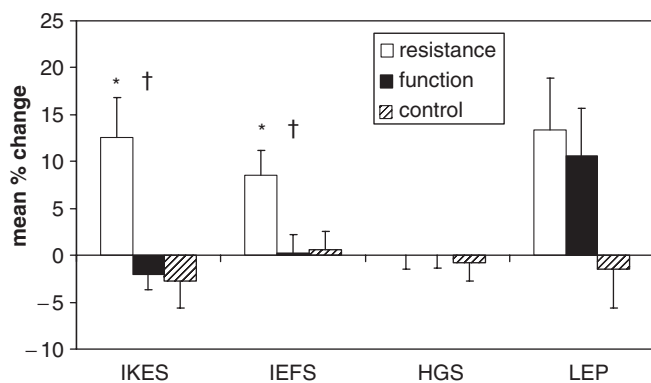


Figure 2. Mean percentage change muscle function tests between baseline and 3-month measurements. $P \leq .05$ analysis of variance with a Bonferroni correction for comparison between *resistance and control groups and †resistance and function groups. IKES = isometric knee extensor strength; IEFS = isometric elbow flexor strength; HGS = handgrip strength; LEP = leg extension power.

The changes in IKES, IEFS, and HGS between baseline and 9 months were not significantly different between the control, resistance, and function groups. LEP was significantly higher for the resistance and function groups than for the control group.

DISCUSSION

To the authors' knowledge, this is the first randomized, controlled trial to demonstrate that functional-task exercise improves the performance of daily tasks by healthy community-living older women significantly more than resistance strength exercise does. Moreover, this improvement was sustained after a 6-month detraining period. Although isometric knee and elbow strength was greater in the resistance group than in the function and control groups immediately after training, this gain in muscle strength was lost after 6 months of detraining.

The effects of functional-task exercise on functional performance correspond with those reported by two other studies^{10,27} on the Cs-PFP test, after which the ADAP was patterned. After a 6-month period of combined stair climbing, lower body endurance, and resistance exercise, improvements in the Cs-PFP total, upper body strength, lower body strength, and endurance scores were found,²⁷ and strength training was found to have a limited effect on the Cs-PFP test.¹⁰ Recent reviews of randomized, controlled trials have found that the effects of resistance exercise programs on functional-task performance of older adults were inconsistent and of modest magnitude.^{3,7} The fact that most exercise programs are not consistent with the principles of training specificity could explain this. According to this principle, the nature of the implied stimulus determines the nature of the physical change.¹⁴ Thus, exercises should focus on the complex interplay of cognitive, perceptual, and motor functions that are involved in the performance of daily tasks.³⁴ Furthermore, daily task performance is most frequently assessed using questionnaires about activities of daily living.^{9,35} Nevertheless, these instruments often fail to detect changes because of ceiling effects in relatively healthy participants.^{7,26} In addition, in many trials, an increase in

muscle strength or gait speed is equated with improved daily task performance,^{4,11–13,36} although this association has not been indisputably demonstrated.

This is the first study to show that functional-task and strength-training programs have different effects over time after detraining. Although the improvements in ADAP score achieved in the function group lasted over the 6-month detraining period, this was not the case for the muscle strength gains in the resistance group, thereby confirming the results of another study that showed a loss of muscle strength with strengthening regimens during a detraining period.¹³ Nevertheless, the changes in LEP were significantly higher for the resistance and function groups than for the control group, although it should be borne in mind that changes in physical activity during the 6-month detraining period could have influenced the results at the 9-month follow-up. Because the exercises of the functional-task exercise program resembled daily tasks, the participants may have been stimulated to become more active in their free time. In contrast, the resistance exercises are less transferable to daily life situations, and so the resistance group participants were probably less likely to continue with these exercises in their free time. Further research on this topic is necessary to determine whether the functional-task exercise program has a different motivational effect on activity than the resistance exercise program.

The recruitment strategy used, namely, advertisements in the local newspaper, may have recruited a relatively healthy population. It was assumed that, by excluding the most active respondents (respondents who exercised at a sports club more than two times a week), a more representative group of participants would be obtained, although the SAS scores showed that the respondents were in moderate to good health, a finding that the results of the TUG test and IKES supported.^{25,37}

A possible weakness of this study was that, because 25% of the included participants did not participate in the 9-month follow-up, a selection bias may have occurred at 9 months. Nevertheless, *t* test analyses of baseline scores demonstrated that the dropouts between the baseline and 3-month measurements and between the 3-month and 9-month measurements did not differ from the participants who completed the study and that dropout did not lead to an altered group composition. Also, exercise intensity in both exercise programs was moderate to high. Although the increases at 3 months in IKES and IEFS in the resistance group were consistent with earlier results obtained with comparable resistance exercise programs,^{9,12,36,38} the American College of Sports Medicine has suggested that higher intensity resistance training could induce higher strength gains.⁶ Further research is needed to determine whether higher strength gains are required to translate into functional gains.

In conclusion, this study demonstrates the functional-task exercise to be more effective than a resistance exercise program on the performance of daily tasks by healthy community-living older women. Moreover, the effects of the functional-task exercises were preserved for longer than the gain in strength achieved with resistance exercises. Future research should consider specific functional tasks when designing exercise interventions to increase the ability of older individuals to perform daily tasks.

Table 3. Changes in Outcome Measures Between Baseline and 9-Month Measures

Measure	Control Group (n = 23)			Resistance Group (n = 24)			Function Group (n = 27)			Resistance Versus Function	
	Mean ± SD	95% CI	P-value*	Mean ± SD	95% CI	P-value†	Mean ± SD	95% CI	P-value‡	P-value‡	P-value‡
Assessment of daily activity performance											
Total	1.2 ± 4.8	- 1.0-3.1	.29	3.0 ± 4.7	1.0-5.1	.52	6.1 ± 5.0	4.0-8.2	.002		.10
Upper body strength	0.1 ± 3.8	- 1.5-1.8	.88	1.8 ± 4.0	0.0-3.6	.77	4.1 ± 6.4	1.4-6.8	.02		.35
Lower body strength	1.7 ± 5.3	- 0.5-4.0	.12	2.9 ± 4.8	0.8-5.0	1.00	6.0 ± 6.2	3.4-8.7	.03		.17
Upper body flexibility	0.3 ± 11.2	- 4.8-4.8	.99	0.9 ± 11.5	- 4.2-6.0	1.00	5.1 ± 11.4	0.2-9.9	.39		.65
Balance and coordination	3.5 ± 7.3	- 0.2-6.3	.06	5.3 ± 6.6	2.4-8.2	.90	8.7 ± 7.3	5.6-11.8	.03		.33
Endurance	1.9 ± 6.2	- 1.0-4.3	.22	3.3 ± 5.5	0.9-5.8	.09	7.3 ± 6.1	4.7-9.9	.005		.08
TUG, seconds	0.6 ± 0.9	0.2-1.0	.009	0.3 ± 0.8	0.0-0.7	1.00	0.2 ± 0.7	- 0.1-0.6	.43		1.00
Isometric knee extensor strength, N	- 7.2 ± 40.4	- 24.6-10.3	.87	0.4 ± 42.1	- 18.2-19.1	1.00	- 10.7 ± 20.6	- 19.6 to - 1.8	1.00		.90
Handgrip strength, kgF	0.8 ± 2.0	- 0.1-1.6	.07	- 0.1 ± 2.6	- 1.3-1.0	.40	0.4 ± 1.5	- 0.3-1.0	1.00		1.00
Isometric elbow flexor strength, N	7.6 ± 27.6	- 4.4-19.5	.20	4.8 ± 27.5	- 7.4-17.0	1.00	4.3 ± 23.5	- 5.6-14.2	1.00		1.00
Leg extensor power, W	- 6.2 ± 29.6	- 19.0-6.6	.33	16.5 ± 24.1	5.8-27.2	.01	17.2 ± 24.0	7.1-27.4	.009		1.00

Note: Positive change scores indicate improvement, except for Timed up and go (TUG) scores.

* T test mean change between baseline and 3-month scores control group.

† Analysis of variance (ANOVA) with a Bonferroni correction for comparison between exercise group and control group.

‡ ANOVA with a Bonferroni correction for comparison between resistance group and function group.

SD = standard deviation; CI = confidence interval; kgF = kg force; N = newtons; W = watts.

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