Functional Fitness Gain Varies in Older Adults Depending on Exercise Mode

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ABSTRACT

TAKESHIMA, N., N. L. ROGERS, M. E. ROGERS, M. M. ISLAM, D. KOIZUMI, and S. LEE. Functional Fitness Gain Varies in Older Adults Depending on Exercise Mode. *Med. Sci. Sports Exerc.*, Vol. 39, No. 11, pp. 2036–2043, 2007. Various exercise modes are available to improve functional fitness (FF) in older adults. However, information on the comparative capability of different exercise modes to improve FF is insufficient. **Purpose:** To compare the effects of aerobic, resistance, flexibility, balance, and Tai Chi programs on FF in Japanese older adults. **Methods:** FF was evaluated using a chair stand, arm curl, up and go, sit and reach, back scratch, functional reach, and 12-min walk. One hundred thirteen older adults (73 ± 6 yr, 64 men, 49 women) volunteered for one of five exercise groups: aerobic (AER), resistance (RES), balance (BAL), flexibility (FLEX), and Tai Chi (T-CHI), or they were assigned to the wait-list control group (CON). Programs were performed for 12 wk, 2 d·wk^{-1} (RES, BAL, FLEX, T-CHI) or 3 d·wk^{-1} (AER), and 90 min·d^{-1}. **Results:** Improvement in cardiorespiratory fitness was limited to AER (16%). Improvements in upper- and lower-body strength and balance/agility were outcomes of RES, BAL, and T-CHI. RES elicited the greatest upper-body strength improvement (31%), whereas BAL produced the greatest improvement in lower-body strength (40%). Improvements in balance/agility were similar across RES (10%), BAL (10%), and T-CHI (10%). Functional reach improved similarly in AER (13%), BAL (16%), and RES (15%). There were no improvements in flexibility. **Conclusion:** Results suggest that a single mode with crossover effects could address multiple components of fitness. Therefore, a well-rounded exercise program may only need to consist of two types of exercise to improve the components of functional fitness. One type should be aerobic exercise, and the second type could be chosen from RES, BAL, and T-CHI. **Key Words:** SPECIFICITY OF TRAINING, FUNCTIONAL FITNESS, WELL-ROUNDED EXERCISES, JAPANESE

Functional fitness is a concept that reflects an older adult's ability to perform physical activities of daily life with relative ease (32). This concept accounts for traditional physical fitness parameters such as muscle strength, cardiorespiratory endurance, and flexibility, but it also includes balance. Even in healthy adults, each component of functional fitness declines with advancing age, negatively affecting quality of life (15). For example, the age-associated decline in muscle strength is a major cause of physical disability in older people (14), and decreased muscular strength and poor balance are major risk factors for falls (34). Furthermore, impaired joint flexibility can negatively affect the ability to perform self-care activities such as bathing and dressing. Much attention has been focused on regular physical activity as a means to enhance health and maintain function in old age, and several exercise programs have been designed to improve the parameters of fitness and, in turn, enhance function (1,2).

It is established that aerobic exercises such as walking and running improve cardiorespiratory endurance in older adults with walking, eliciting impact forces that are 3.6 times less than those of running (42), resulting in low bone-joint stress in lower extremities (30). Considering the orthopedic and other medical factors associated with aging, walking is an often-prescribed exercise mode for older people to promote cardiorespiratory fitness (43); indeed, walking has been reported to be the most common physical activity reported by adults in the United States, Canada, and Europe (13).

Sarcopenia (loss of muscle mass) in aging is also well documented (18). Musculoskeletal weakness and disability is especially common among older women and, along with compromised flexibility and balance, contributes to functional disability and the risk of falls (14). Strength training can result in improvements in muscle size and strength in elderly men and women (33). It can also improve balance

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and gait speed in very old and frail nursing home residents, improve bone health, and decrease many of the risk factors for an osteoporotic fracture (16).

In many cases, poor postural balance is a primary risk factor for falls (29,40). Although sometimes difficult to define and measure, postural balance is basically the ability to maintain the body's position over its base of support, whether the base is stationary or moving (36). Fortunately, research indicates that balance exercise programs can improve postural balance (7,20,37) in older adults.

Tai Chi, an ancient mode of Chinese exercise, is reported to target physiological systems that monitor balance. Tai Chi consists of a series of fluid movements that are linked together. These movements require weight shifting, coordinated arm and leg movements, trunk rotation, hip and knee flexion/extension, and postural control. Tai Chi has been shown to improve postural balance under a variety of conditions with subsequent reductions in fall risk (46). Tai Chi is also reported to be beneficial to flexibility, microcirculation, and psychological parameters in addition to postural balance (25,27). Tai Chi can be classified as moderate-intensity exercise because it does not demand more than approximately 55% of maximal oxygen intake (27); thus, it is a suitable mode of exercise for older adults.

Although many studies have investigated various effects of each exercise mode, it is not clear how each specific mode of exercise affects the individual components of functional fitness in older adults. Therefore, the aim of this study was to directly compare the effects of a walking-based aerobic program, a band-based resistance program, a stretching-based flexibility program, a customized balance program, and a Tai Chi program on functional fitness in a group of community-dwelling older adults.

METHODS

Participants. Because of resource restrictions and the translational focus of this study, rolling enrollment using a nonrandomized design was used, resulting in unequal sample sizes. A limitation of this approach is the lack of randomization of subjects to the intervention groups. Thus, this study used a quasiexperimental, nonequivalent control group design. Although not optimal, this design is reported to be an acceptable alternative to an experimental design when randomization is not possible (9,24).

A total of 133 people responded to the advertisements. Before acceptance into the study, a medical examination was performed, and questionnaires regarding medical history and physical activity were completed. Volunteers were excluded if they were taking medication prescribed for hypertension or hormone replacement therapy, had diagnosed coronary heart disease, or were participating in regular physical activity beyond that required for normal daily living. The remaining 117 healthy older adults (73 ± 6 yr, 64 men and 49 women) were sedentary but apparently healthy, although they had conditions and medication use typical of an older population. Subjects volunteered to participate in one of five exercise groups: aerobic (AER) (N = 13), resistance (RES) (N = 17), balance (BAL) (N = 15), flexibility (FLEX) (N = 16), and Tai Chi (T-CHI) (N = 31), or they were assigned to a wait-list control group (CON) (N = 25). The ethical committee of the Graduate School of Natural Sciences at Nagoya City University approved the study. All participants received written and oral instructions for the study and each gave their written informed consent before participation.

Measurement of functional fitness. A battery of field tests specifically developed for older adults were used to assess the components of functional fitness. These tests require very little time or equipment and are designed to be conducted in community settings. Using a standardized protocol, each test was conducted individually, with the exception of the 12-min walk, which was conducted in small groups of four to six people. In this case, participants were instructed to set their own pace and to not walk with others. These tests have been shown to have content and construct validity as well as good test–retest reliability (17,28,31,38). After measurement of height and weight, body mass index (BMI) was computed as body weight (kg) divided by the square of height (m). Upper-body strength and endurance was assessed using the 30-s Arm Curl Test (arm curl) (31). On a signal, participants were instructed to flex and extend the elbow of the dominant hand, lifting a weight (men: 8-lb dumbbell, women: 5-lb dumbbell) through the complete range of motion, as many times as possible in 30 s. After demonstration by the tester, a practice trial of one or two repetitions was given, followed by one 30-s test trial. The score was the number of repetitions completed within 30 s.

Lower-body strength and endurance were assessed using the 30-s Chair Stand Test (chair stand) (31). On a signal, participants rose to a full standing position from a chair and then returned to a fully seated position, and they continued to complete as many full stands as possible in 30 s. After demonstration by the tester, a practice trial of one to three repetitions was given, followed by one 30-s test trial. The score was the total number of stands executed correctly within 30 s.

Balance and agility were assessed using the 8-ft Up and Go Test (up and go) (31) and Functional Reach Test (functional reach) (17). To perform up and go, participants were fully seated in a chair, hands on thighs and feet flat on the floor. On a signal, participants stood from the chair, walked as quickly as possible around a cone which was placed 8 ft (2.44 m) ahead of the chair, and returned to a fully seated position on the chair. Participants were told that this was a timed test and that the objective was to walk as quickly as possible (without running) around the cone and back to the chair. After demonstration by the tester, participants were given one practice trial and two test trials. The best performance time of the test trials was recorded in units of 0.1 s. To perform the functional reach, the functional reach scale (graduated in centimeters) was hung from a wall at a height suitable for the participant. After demonstration by the tester, participants were given one practice trial and two test trials. The participant stood by the wall with feet together, hands clasped and both arms raised in front horizontally and held at the 0-cm level of the scale. On a signal, the participant leaned forward, moving the hands forward along the scale as far possible while keeping the heels in contact with the ground. Performance was assessed as the maximal distance the participant could reach forward beyond arms' length and without taking a step.

Upper-body flexibility was assessed using the Back Scratch Test (back scratch) (31). Participants placed one hand behind the same side shoulder with the forearm pronated and fingers extended and other hand behind the back. After demonstration by the tester, participants were asked to determine the preferred hand, and were given two practice trials, followed by two test trials. The score was the number of centimeters the middle fingers were short of touching (minus score) or overlapped each other (plus score). The best score of test trials was used to evaluate performance.

Lower-body flexibility was assessed using the Chair Sit and Reach Test (sit and reach) (31). Participants sat on the edge of a chair with one leg bent and the other leg extended straight in front with the heel on the floor. Without bending the knee, participants slowly reached forward, sliding the hands down the extended leg in an attempt to touch the toes. After demonstration by the tester, participants were asked to determine the preferred leg and were given two practice trials on that leg, followed by two test trials. The score was the number of centimeters short of reaching the toes (minus score) or reached beyond the toes (plus score). The best score of two test trials was used to evaluate performance.

Cardiorespiratory fitness was assessed by performing the 12-min Walk Test (38,45), which assessed the maximum distance walked in 12 min around a 60-m rectangular course marked into 5-m segments. The score was the total number of meters walked in 12 min.

Exercise-training interventions. The exercise programs were supervised and were performed for 12 wk on 2 d·wk^{-1} (RES, BAL, FLEX, and T-CHI) or 3 d·wk^{-1} (AER) for 90 min·d^{-1}. Frequency of training was based on the minimum number of days per week recommended by ACSM for performing aerobic, resistance, and flexibility training (1). Recommendations for the frequency of balance training vary widely, with a recent ACSM best practices paper recommending 1–7 d of balance training (10). To match the frequency of resistance and flexibility training, 2 d·wk^{-1} was chosen for balance and Tai Chi exercise. Each exercise program consisted of general warm-up exercises (10–15 min), specific exercise (60–70 min; walking for AER, band-based resistance exercise for RES, customized balance exercises for BAL, stretching for FLEX, and Tai Chi for T-CHI), and cool-down/relaxation exercises (10–15 min). AER participants performed walking outdoors. All other groups performed training at a university training center. Participants in each exercise group were asked to maintain their usual levels of activity outside of the time engaged in the intervention sessions. Likewise, CON participants were instructed to maintain their usual levels of activity for the duration of this study.

Aerobic intervention. Participants met at parks near the university and were instructed to walk continuously around the park as much as possible during the exercise class. Participants wore an accelerometer at waist level during each class to monitor the number and intensity of steps taken. When participants were doing brisk walking, they were instructed to achieve an intensity corresponding to a heart rate of 100–120 bpm. Maximal heart rate (HRmax) was not measured directly; however, in a previous study we found that an HR of 100–120 bpm represented an intensity of 70–80% of HRmax for people aged approximately 70 yr (39). Therefore, each participant wore a heart rate–monitoring device (Accurex Plus, Polar Electro, Kempele, Finland) that continuously monitored his or her HR during the class. Accelerometer and HR monitoring were used for session feedback but were not collected or analyzed.

Resistance intervention. The RES participants performed elastic band–based (Thera-Band, Hygenic Corporation, Akron, OH) resistance exercises for all major muscle groups. Participants were instructed to progressively increase resistance every 2–4 wk by advancing to the next color of elastic band (lower to higher resistance of bands, in order: tan, yellow, red, green, blue, black, silver, and gold). Specifically, participants were instructed to change bands when they were able to perform 20 repetitions of a given motion with little exertion. Exertion was rated using Borg's Rate of Perceived Exertion (RPE) scale (5). Participants were instructed to start resistance exercises at an intensity level of 11–13 of Borg's RPE scale and then to progressively increase to a level of 15–17. Participants were instructed to not hold their breath during exercises, minimize exercise-induced blood pressure elevations. The instructor and assistants supervised performance of all exercises.

Balance intervention. BAL participants performed customized balance exercises (34) designed to challenge the visual (e.g., open/close eyes), vestibular (e.g., move head), and somatosensory (e.g., stand on foam) systems. Exercises were initially performed while standing on the floor (first 4 wk) and then progressed to standing on foam pads (Thera-Band Stability Trainers, Hygenic Corporation, Akron, OH) of two different compliances. The instructor and assistants supervised performance of all exercises.

Flexibility intervention. The FLEX participants performed 15 static stretching exercises for the upper and lower body. They performed stretching while sitting or lying on exercise mats. Exercises were performed slowly, holding each position for approximately 15–20 s. Participants were instructed to stretch to a point of moderate tension without pain in the joints or muscles, gradually increasing the range of motion. The instructor and assistants supervised performance of all of exercises.

Tai Chi exercise. T-CHI participants performed a 24-form Yang-style Tai Chi exercise, the most popular form of Tai Chi (47). The standardized 24 forms were proposed by the government of the People's Republic of China in 1956 and have been adopted to reduce the complexity and time required to complete more traditional styles of Tai Chi. Sessions were lead by a Tai Chi master who explained how movements (forms) were to be performed and then performed the movements with participants simulating the motions throughout each session.

Statistical analysis. Sample size was determined according to published (8,12,20,35,45) and unpublished functional fitness data. Training effects indicated that a sample size of 12 subjects per group was required for power of 0.80. Data analysis was completed using the statistical software program SPSS for Windows V.14.0 (SPSS Inc., Chicago, IL). Absolute values were used for statistical analysis. However, when discussing differences between groups, relative change is used to normalize differences because each functional fitness measure uses a unique scale. Data were screened for outliers and assumptions of normality and homoscedasticity. To reduce the potential influence of outliers on the statistical analysis, box-and-whiskers plots were used to identify outliers, which were subsequently eliminated before analysis. Each variable was examined for normality using the Kolomogorov–Smirnov test. Assumptions of homogeneity of variance and sphericity were evaluated. Baseline group mean comparisons were performed using a one-way ANOVA with follow-up *post hoc* analysis to determine group differences. Evaluating functional fitness used more than one testing instrument, and, therefore, a multivariate ANOVA was initially used as an omnibus test. Subsequent repeated-measures ANOVA procedures were conducted for each instrument, contingent on the multivariate ANOVA reaching statistical significance (ANOVA, Wilk's criterion). Group (AER, RES, BAL, FLEX, T-CHI, CON) served as the between-subject factor, and time (pre- and posttest) served as the within-subject factor. Follow-up *post hoc* analyses were used to determine group differences. A probability value of less than 0.05 was considered statistically significant.

RESULTS

Normality and assumptions. Nonsignificant Kolomogorov–Smirnov tests indicated that all variables were normally distributed. In addition, histograms and normal Q–Q plots revealed normal distributions of variables in all groups. Assumptions of homogeneity of variance and sphericity were evaluated and not violated.

Pretraining data. No significant difference was noted at baseline in age, height, weight, or BMI among the groups (Table 1). No significant baseline difference was noted in any measured functional fitness variable among the groups (data not shown).

Training data. Participants reported no incidence of injury during the study. Mean attendance rate for all participants was 91.7%. Four participants of the T-CHI dropped out of the study because of personal and/or family issues.

Intervention effectiveness. Figure 1 presents the relative change of functional fitness measures in each of the six groups after 12 wk. The multivariate ANOVA revealed a significant interaction (F = 4.43, $P \leq 0.01$, η^2 = 0.23), necessitating subsequent repeated-measures ANOVA. There was no change over time in CON or FLEX on any measure. However, differences were noted for arm curl, chair stand, up and go, functional reach, and 12-min walk, indicating differences in the response of exercise groups to the training. Improvement in cardiorespiratory fitness, as measured by the 12-min walk, was limited to AER. Improvements in upper-body strength, lower-body strength, and balance/agility were outcomes of RES, BAL, and T-CHI. Functional reach was improved through participation in AER, RES, and BAL.

As noted above, following 12 wk of training, cardiorespiratory fitness improved significantly only in AER (16%). Consequently, between-group differences were noted between AER and all other exercise groups (Fig. 1A).

Upper-body strength, as measured by arm curl, improved significantly in RES, BAL, and T-CHI (Fig. 1B). Between these three groups, RES training resulted in the greatest arm curl improvement (31%) and showed significantly greater improvement compared with BAL (20%). There was no difference between RES (31%) and T-CHI (25%) and no difference between T-CHI (25%) and BAL (20%). Lower-body strength, as measured by chair stand, improved significantly in RES, BAL, and T-CHI (Fig. 1C). BAL training resulted in the greatest lower-body strength improvement (40%) whereas no differences existed between RES (33%) and T-CHI (34%).

Up and go improved significantly in RES (10%), BAL (10%), and T-CHI (12%), but no differences were observed between these groups (Fig. 1D). Functional reach improved significantly and similarly in AER (13%), BAL (16%), and RES (15%) (Fig. 1E).

TABLE 1. Baseline characteristics of participants (mean ± SD).

	CON (*N* = 25)	AER (*N* = 13)	RES (*N* = 17)	BAL (*N* = 15)	FLEX (*N* = 16)	T-CHI (*N* = 27)	Total (*N* = 113)
Age	73.2 ± 7.6	71.6 ± 7.1	71.4 ± 4.3	75.6 ± 4.6	73.2 ± 7.1	72.4 ± 5.4	73.1 ± 6.2
Height (m)	1.6 ± 0.07	1.5 ± 0.07	1.6 ± 0.08	1.5 ± 0.08	1.5 ± 0.06	1.5 ± 0.09	1.6 ± 0.07
Weight (kg)	56.3 ± 8.4	53.8 ± 7.9	56.0 ± 10.7	55.8 ± 8.9	57.4 ± 7.2	56.6 ± 9.9	56.1 ± 9.0
BMI	22.8 ± 2.3	22.6 ± 3.3	23.3 ± 3.9	23.6 ± 3.9	23.2 ± 2.0	23.3 ± 3.2	23.1 ± 3.1

CON, control group; AER, aerobic intervention; RES, resistance intervention; BAL, balance intervention; FLEX, flexibility intervention; T-CHI, tai chi intervention.

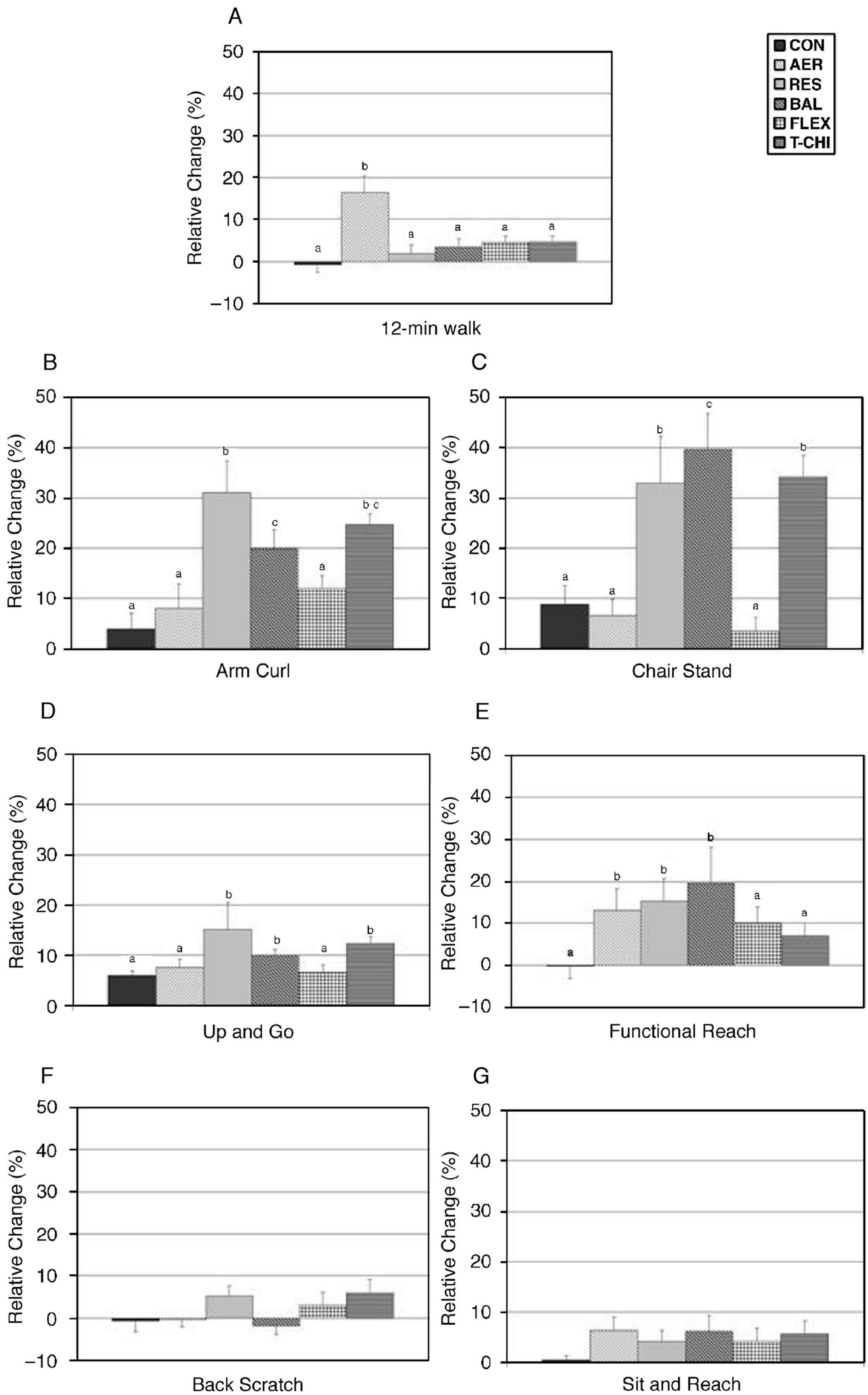

FIGURE 1—Relative change and standard error of the mean after 12 wk in each group for *(A)* 12-min walk, *(B)* arm curl, *(C)* chair stand, *(D)* up and go, *(E)* functional reach, *(F)* back scratch, and *(G)* sit and reach. CON, control group; AER, aerobic intervention; RES, resistance intervention; BAL, balance intervention; FLEX, flexibility intervention; T-CHI, Tai Chi intervention. Unlike letters denote significant group differences at $P < 0.05$.

There were no significant improvements in flexibility variables among exercise groups (Fig. 1F, G).

DISCUSSION

Aging is associated with a gradual decrease in the components of functional fitness, which compromises the ability to perform daily tasks such housework, carrying groceries, and climbing stairs (31). Results of the present study demonstrate the effectiveness of five different modes of training to improve individual components of functional fitness. Improvement in cardiorespiratory fitness resulted from participation in the aerobic intervention. Improvements in upper-body strength, lower-body strength, and balance/agility were outcomes of the resistance, balance, and Tai Chi interventions. None of the programs, including flexibility training, improved flexibility.

In the current study, improvement in cardiorespiratory fitness was limited to participants in the AER intervention. The failure of the other programs to induce improvements in cardiorespiratory fitness is similar to results of Cavani et al. (8), who found that a combination of strength and flexibility training improved several components of functional fitness, including arm curl, chair stand, and up and go performance, but not 6-min walk distance. This illustrates the specificity of aerobic training, and, as such, our results suggest that to improve cardiorespiratory fitness, older adults need to include some type of aerobic specific activity.

Results of the present study suggest that three types of training are beneficial for improving muscular strength. The RES, BAL, and T-CHI training modes all resulted in improved strength after 12 wk of training. It seems that for upper-body strength, elastic band–based resistance training will result in the greatest improvement when compared with balance and Tai Chi training, indicating the specificity of this training mode. In the Tai Chi and balance groups, participants made frequent hand movements that were controlled and semiisometric in nature while performing their group-specific exercises, likely explaining the modest improvement in upper-body strength.

With respect to lower-body strength, results indicate that resistance, balance, and Tai Chi training are all effective in improving strength. It seems that balance training is most effective and results in greater strength gains. Similar lower-body strength gains were noted in one of our previous studies (20), in which participants performed almost identical balance exercises. However, these results differ from those of Wolfson et al. (44), who found that 12 wk of balance training improved balance measures but did not improve lower-body strength, whereas strength training improved strength but had little effect on balance. Although balance and Tai Chi exercises both involved standing for extended periods of time supporting body weight as a strength training stimulus, more time was spent on one leg supporting total body weight and standing on unstable surfaces during the balance intervention. The unstable surfaces challenged not only balance, but also lower-body strength as adjustments were made to unexpected weight shifts and perturbations. It is likely that the unstable surfaces required greater muscle activation to counteract increased sway. This is supported by previous research reporting that unstable surfaces, such as foam pads, balance boards, and exercise balls, increase muscle activation and speed of contraction more than stable surfaces (4,6,19). In agreement with the current results, previous reports (3,21–23,35) have found elastic band–based resistance exercise to be effective in improving muscular strength in older adults. Although the resistance intervention was effective in improving lower-body strength, it was not the most effective intervention. It is possible that this chair-based program provided a lower stimulus compared with the balance program. However, it should be noted that such a chair-based program would be particularly suitable for individuals who find standing activities too difficult.

It has been reported that conventional exercises such as aerobic or flexibility training often fail to improve balance (11). In our study, functional reach improved in aerobic, resistance, and balance interventions. It is surprising that Tai Chi failed to improve functional reach, because previous research does indicate Tai Chi to be effective in improving balance (26). Because the present study only measured functional reach in the forward direction, improvements in the lateral and backward directions may have gone undetected. Previous research has reported improvements in maximum lean in the lateral and backward directions without improvements in the forward direction using computerized posturography (20). However, because the premise of the paper was to use field tests that could be conducted in community settings, the test for functional reach may not have been global enough to detect improvements in overall balance. Tai Chi did improve performance during the up and go, a measure of agility and dynamic balance, as did the resistance and balance programs.

Other studies have demonstrated improvements in back scratch performance after resistance training alone (8) and resistance [and] balance programs (12) in older adults. However, no significant changes were noted in any intervention group for upper- or lower-body flexibility in the current study. Flexibility is important for the performance of activities of daily living as well as in the avoidance of falls. It is also possible that the back scratch and sit and reach used for the indexes of flexibility in the current study were not sensitive enough to detect changes in flexibility, or that the training stimulus was insufficient to promote improvement.

Previous studies assessing multicomponent exercise programs report functional fitness improvements in older adults. For example, a 9-wk program consisting of aerobic, strength, and flexibility improved chair stand, arm curl, 6-min walk, and up-and-go performance (41), and a 10-wk program consisting of strength, balance, and flexibility improved chair stand, arm curl, up and go, and back scratch performance (12). Our results suggest that training components can cross over into domains not specifically targeted in their design, so that the combination of aerobic exercise (e.g., walking) and a second mode with crossover effects could improve multiple components of functional fitness. When choosing the second mode, the needs of the older adult should be considered. If improved balance is the goal, our findings indicate that the resistance and balance programs improved *both* measures of balance, and, thus, one of these programs should be considered. If lower-body strength is the focus, older adults may wish to participate in balance training over resistance or Tai-Chi, because balance training produced significantly greater lower-body strength improvement. With respect to upper-body strength, the resistance program was most effective and should be recommended for such, although gains can also be achieved through balance or Tai Chi training. Although our flexibility program did not result in improvements, flexibility training is recognized as an important component of a well-rounded exercise program (2,10) and, thus, should be included.

When interpreting results, it is important to consider the limitations inherent to this translational community-based study. Foremost is the nonrandomized design in which participants selected their intervention. Although this quasiexperimental, nonequivalent design has been reported to be an acceptable alternative when randomization is not possible, such a design is less than optimal. However, when recommending an exercise regimen, it is important to consider the interests of the individual older adult. The high adherence rates observed in the current study may be attributed to volunteers selecting their program of participation. It should also be noted that although participants selected their intervention, there were no differences on any baseline measure, indicating similarity between groups at the time of enrollment. Moreover, because of the self-selected convenience sample, the generalizability of results is limited to sedentary older adults who are willing and able to participate in an exercise program. Thus, it is impossible to know whether these outcomes are attainable for all community-dwelling older adults. In addition, although participants were sedentary and apparently healthy, they did share common conditions and medication use customary in older adults, and this may have affected adaptability to the training programs. The use of field tests to assess the components of functional fitness may also limit study outcomes. Although these tests have been shown to be reliable and valid assessments, they are not as sensitive as more sophisticated laboratory measures in detecting change. Finally, because of the small sample size, caution should be taken when developing generalizations. Researchers of future studies may consider extending this line of research to larger groups.

CONCLUSIONS

The ACSM recommends that older adults participate in a well-rounded exercise program consisting of four modes (aerobic + resistance + flexibility + balance), rather than a single mode, to improve overall fitness and, in turn, prevent or ameliorate age-associated declines in function (2,10). The results of the present study suggest that elastic resistance, customized balance training, and Tai Chi all improve upper- and lower-body strength as well as balance. Thus, it seems that the impact of these training programs crosses over into domains not specifically targeted in their design (i.e., resistance training improves balance, and balance training improves strength). However, unlike strength and balance, the specificity of aerobic training necessitates that older adults participate in some type of aerobic-specific activity if they desire to improve cardiorespiratory fitness. With respect to flexibility, a lack of improvement suggests that further study is needed to explore the effect of flexibility exercise training in older adults.

In conclusion, a well-rounded exercise program can be achieved by choosing a single strategy that addresses multiple components of fitness (e.g., strength or balance training) in combination with aerobic training. Additional research is needed to determine the specific types and amounts of exercise that should be performed to provide optimal functional fitness benefits as well as their long-term benefits.

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