THE BENEFITS OF A FUNCTIONAL EXERCISE CIRCUIT FOR OLDER ADULTS

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ABSTRACT. Whitehurst, M.A., B.L. Johnson, C.M. Parker, L.E. Brown, and A.M. Ford. The benefits of a functional exercise circuit for older adults. J. Strength Cond. Res. 19(3):647-651. 2005.—The physical benefits of a functional exercise circuit are not well known in an elderly population. The purpose of this study was to evaluate the effect of a functional exercise circuit on mobility and perceived health in the elderly. Subjects were 119 men and women (aged 74 ±4.2 years) who received pre-and posttests of mobility (e.g., sit to stand, get up and go, timed walk), flexibility (sit and reach), and balance (standing reach) and who completed the Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36). A supervised functional exercise circuit that included 10 different upper- and lower-body exercises performed under time constraints was performed 3 times per week for 12 consecutive weeks. Paired t-tests showed significant differences at posttest for the get up and go (p < 0.001), standing reach (p < 0.001), sit and reach (p < 0.001), and selected items from the SF-36, including physical functioning (p < 0.001), pain (p = 0.001), vitality (p = 0.001), and number of doctor visits (p < 0.001). A functional exercise circuit such as the one employed in this study may offer promise as an effective means of promoting mobility and perceived health in older adults.

KEY WORDS. enhanced mobility, perceived health

INTRODUCTION

While resistance exercise has been used extensively during the past decade to promote strength, muscle hypertrophy, and mobility in the elderly (6, 7, 10, 17), few if any studies have reported using a functional approach in which movement patterns common to activities of daily living (ADL) were employed as the primary exercise stimulus. The idea that exercise should be strict linear movements typical of resistance machines and free weights may be impractical for many older adults. Rather, a functional exercise, particularly one performed in a circuit fashion, may be well suited to older persons wishing to improve function and mobility.

Using an exercise circuit to induce physiological stress in an effort to promote health-related fitness is not new. For example, circuit weight training has been shown to improve strength and, to a lesser extent, cardiorespiratory endurance in young, healthy subjects (8, 19). Similarly, circuit or workstation exercise interventions have been used to improve function and physical work capacity in stroke patients (4, 12) and cardiac patients (5). In a recent study, Nelson et al. (13) exposed older adults to a home-based exercise program that included progressive resistance exercise and mobility challenges. Nelson and colleagues found significant improvements in dynamic balance, whereas strength and gait speed did not differ between exercise and control groups. Although the authors concluded that a home-based exercise program offers benefits, it could be argued that their failure to find significant results across all outcome measures resulted from the older subject's inability to perform exercises correctly in the absence of feedback and/or sustain an appropriate intensity throughout the exercise session.

Our intention was to develop a functional exercise circuit that required movement patterns and mobility challenges common to ADL. In doing so, we sought to provide a supervised exercise setting and effectively eliminate the need for specialized equipment while providing physically demanding exercise performed in a group setting. We hypothesized that the functional exercise circuit would provide an exercise stimulus suitable for improving functional mobility in older adults. In addition, considering that a psychologic benefit is often attributed to regular exercise (1), we examined the influence of the functional exercise circuit on perceived health. Again, consistent with other forms of exercise, we hypothesized that the benefits of the functional exercise circuit would extend beyond the physical.

METHODS

Subjects

This study sought to determine whether elderly subjects could improve their mobility and perceived health from a nontraditional functionally (i.e., movement patterns common to ADL) based exercise program. This study was approved by Florida Atlantic University's Institutional Review Board for Human Subjects Research. Subjects were 119 (aged 73 ±4.6 years) volunteers from Palm Beach County, Florida. Upon phone inquiry, subjects were scheduled for a physical examination (an informed consent and a detailed medical history were also obtained). Subjects whose medical history and/or physical examination showed more than 2 major coronary heart disease risk factors and/or who presented with an unstable condition (e.g., heart disease, high blood pressure, abnormal levels of blood lipids) within the last 12 months and/or who had mobility issues were referred to their physician for follow-up (n = 3) and deemed unfit for participation in this study.

Immediately following the physical examination, subjects completed the Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36) and a battery of tests that targeted mobility (e.g., sit to stand, get up and go, timed walk), flexibility (sit and reach), and balance.
(standing reach). The SF-36 (numeric responses, e.g., 1 = all of the time; 6 = none of the time) dealt with general health, physical functioning, mental state, social activity, pain, and vitality. Subjects were also asked to provide the number of falls, emergency room visits, hospitalizations, and doctor visits, where pretest was defined as 12 months prior to their participation in this study. All tests were repeated within 1 week following the conclusion of the 12 weeks of continuous exercise.

**Procedures**

The sit-to-stand maneuver was electronically timed and required the subject to rise from a seated to a standing position, without the aid of the arms, as quickly as possible. The best of 3 trials was recorded. A detailed description of this test may be found elsewhere (18).

The get-up-and-go test required the subject to rise from a seated position, walk 8 ft (2.44 m), turn, and return to the seated position as quickly as possible (14).

The timed walk test was an aerobic endurance test lasting 6 minutes. Briefly, the subject walked a rectangular course (13.4 x 3.35 m) for 6 minutes, covering as much distance as possible (14).

Flexibility was measured in the sit-and-reach position using a standard sit-and-reach box, and the best of 3 trials was recorded (9).

The standing-reach test was a field test of balance and provided a measure of the subject's stability and risk of falling. Subjects stood with the shoulder of the dominant arm next to a wall. Affixed to the wall was a slide. The start position was defined as the subject grasping the handle of the slide mechanism, arm in front of the body and parallel to the floor. The subject moved the slide mechanism forward by leaning forward as far as possible or just prior to the point that a step was necessary to avoid falling. The distance from the start position (measured from the handle on the slide mechanism) to the stopping point was recorded. Each subject received 3 trials, and the greatest reach was recorded. All tests were administered in the order described.

**Functional Exercise Circuit—Overview**

A functional exercise circuit was performed 3 times per week for 12 consecutive weeks. The circuit consisted of 10 exercises or stations performed consecutively, each lasting 60 seconds, with 3 circuits completed each session. During the 60 seconds, participants were able to complete 10-30 repetitions before transitioning (15-20 seconds) to the next station. A total of 15-30 subjects participated in each session. Subjects were monitored at all times to ensure safety and adherence to good form and were instructed to avoid the Valsalva maneuver while performing the different exercises in the circuit. Subjects were not allowed to complete more than several repetitions at each station of the circuit for the first week. More repetitions and hence difficulty were introduced slowly during subsequent weeks (weeks 2-3). A timer called out times (e.g., 15, 30, 45 seconds) during the 60-second interval. Finally, subjects wore a heart rate monitor while exercising and were instructed to monitor their intensity by checking their monitor periodically (training heart rate = 70-80% predicted maximum heart rate) as well as using the Borg scale (13-14). Periodic inspections by the investigators showed that subjects were at or just below 70% of their THR during the functional exercise circuit. Of the 36 possible sessions, subjects averaged slightly more than 30 sessions or 83% of all possible sessions.

While the stations of the circuit required specific movement patterns, the circuit was designed to emphasize level changes, directional changes, and the negotiating of obstacles. In this way, the circuit was more than just a repetitive process. Rather, the configuration of the circuit and its inherent obstacles placed cognitive and attentional demands on the subjects at all times. The stations were labeled by number and name while the subjects rotated through the circuit numerically (1-2 ... 10-1). See Figure 1 for a layout of the exercise circuit.

**Functional Exercise Circuit**

**Wall Exercise.** The subject stood with his or her back to the wall. A large rubber ball (1.06 m) was placed between the midback and the wall. While leaning against the ball, the subject flexed the knees, trying to attain a 90° bend before returning to the straight-legged starting position.

**Single Leg Balance.** With a foam cushion (5.08 cm) positioned near a wall, the subject balanced on 1 leg while standing on the foam cushion. This task was repeated on both legs, approximately 30 seconds per leg.

**Cross-Legged Seated Torso.** The subject assumed a seated cross-legged position (back straight) on the floor to perform a series of 4 gentle stretches. With the arms outstretched and the hands resting on the knees, the first
movement included bending forward at the waist and throughout the spine, in order to move the head toward the floor, and then returning to the straight-back position. The second and third movements required the subject to maintain the straight back while rotating the torso position (arms were allowed to follow the torso but did not provide assistance) as far as possible in one direction and then in the opposite direction. The fourth and final movement required the subject to place the hands behind the buttocks for support while arching the back such that the chest moved toward the ceiling. Each position was held for 3–10 seconds and repeated several times in sequence.

**Modified Push-Up.** From a kneeling position, the hands were placed on the floor, shoulder width apart, and arms straight. The goal was to lower the chest to the floor and return to the straight-arm position. Subjects who could not perform the modified push-up performed wall push-ups in which their feet were shoulder width and parallel and as far from the wall as could be tolerated while they were still able to flex the arms and move the chest as close to the wall as possible.

**Crunch.** While lying on the back, arms crossed against the chest and knees bent so the feet were flat on the floor, the subject tucked the chin against the nuchal and raised the back from the floor as far as possible while, at the same time, contracting the abdominal muscles such that the back rounded and the chest moved toward the bent knees. The subject held the upright position for 1 count before returning the back to the floor and repeating the movement.

**Superman.** While lying facedown on the floor with arms outstretched overhead, the subject lifted the thighs and chest off the floor simultaneously. At the top, the subject paused for 1 count before lowering the chest and thighs to the floor.

**V-Sit.** The subject assumed a seated position with the legs outstretched, the back straight (some subjects placed their hands on either side of the hips to assist in maintaining a straight back), and the feet spread 0.6–1.2 m, depending on individual capability. Alternating between legs, the subject leaned toward an outstretched leg as far as possible. Upon stretching to a comfortable limit, the subject paused and held the stretch for 5–10 seconds before returning to the start position. The subject then stretched toward the other leg. This process was repeated several times for each leg.

**Stretch and Balance.** Standing with feet shoulder width apart and arms at the sides of the body, the subject reached overhead with the right arm while simultaneously abducting the left leg such that that foot left the floor. In the outstretched position, the arm and leg formed a diagonal line that was held for as long as 10 seconds. The same action was repeated for the other side of the body. These movements were repeated 2–4 times per side. Subjects were allowed to hold a chair with the uninvolved hand for support.

**Star Exercise.** Six rubber cones (height = 0.07 m) were positioned in a circle around the subject, with each cone approximately 0.944 m from the subject. While balancing on 1 leg, the subject flexed the knee, reached down, and touched the top of a cone. The subject returned to the upright posture (starting position) before attempting to touch another cone. It should be pointed out that the subjects used opposing limbs (e.g., right leg as the base and left arm to touch the cone). Additionally, the subject was oriented in a constant direction during the task. This meant that touching a cone in the rear required bending and flexing the knee and blindly reaching back. The long-term goal for each subject was for him or her to touch the 6 cones with all combinations of balanced leg and outreached arm. However, not all subjects could touch all cones at all times without temporarily losing balance and having to temporarily stabilize themselves with the other foot.

**Weight Transfer.** The subject picked up tote bags, one in each hand, representing approximately 20% of his or her body weight. With the arms at the sides, the subject walked around the outside of the exercise circuit and through or around obstacles that included stepping over barriers (there were 3 to choose from: 4.7, 7.0, and 9.4 cm), reversing direction, and walking backward while carrying the tote bags.

**Statistical Analyses**

Mean and standard deviation were calculated for each variable. Paired t-tests were used to determine differences over time for each variable. The p ≤ 0.05 was used. All data analysis was completed using SPSS version 11.0 (SPSS Inc., Chicago, IL).

**RESULTS**

As shown in Table 1, paired t-tests detected significant differences in pre- and posttests for get up and go (p = 0.000), standing reach (p = 0.000), sit and reach (p = 0.000), self-reports of physical functioning (p = 0.001), pain (p = 0.001), vitality (p = 0.001), and doctor visits (p = 0.000). The initial alpha level of p = 0.05 was corrected (0.05 per number of paired t-tests or 18).

**DISCUSSION**

This study sought to evaluate the relative value of a functional exercise circuit as a means of promoting mobility and perceived health in an elderly population. On the basis of the results obtained in the get-up-and-go test, it appears that the functional exercise circuit intervention promoted mobility. Although not significant (0.006), the timed walk test, indicative of cardiorespiratory endurance and mobility, improved by 7.4%. These findings are consistent with other studies in which mobility improved in an elderly population following exercise training (6, 7, 10). However, unlike previous studies, the current study employed movements common to ADL, with resistance provided by the subject’s body weight. Given the nature of the circuit (e.g., directional changes, obstacles) and the time limit imposed at each station, we speculate that a progressive overload was produced that manifested itself as improved mobility.

Standing reach, a field measure of stability and fall risk, improved 12.9%. This improvement may be a product of the dynamic nature of the training regimen. A dynamic exercise intervention in the form of agility training was employed in a recent investigation by Liu-Ambrose et al. (11). Using body sway as a measure of fall risk, these authors reported a 29.6 and 30.6% reduction in sway following agility and resistance training. Given that there was no significant difference in body sway following agility or resistance training, it could be argued that the more functionally based agility exercise is at least as good as traditional resistance exercise at reducing the risk of
falling in older subjects. Using another form of dynamic exercise, Tai Chi, Wolf et al. (20) found that Tai Chi training reduced the risk of multiple falls by 47% compared to those of an education group. We would suggest that the functional exercise circuit employed in this study was similar to the aforementioned dynamic training interventions. Assuming as much, a functional or dynamic approach may activate the centers for postural control (i.e., somatosensory, vestibular, visual) (15) with the synaptic plasticity occurring in the postural control centers as a function of repetition and learning (18). Speculatively, an additional benefit of the functional exercise circuit was task complexity. That is, the required movement patterns were not always easy to remember or easy to produce. Hence, the functional exercise circuit represented a continuum of perceptual, cognitive, and action challenges that, over time, may have affected cognitive and cerebellum function as well (16).

The improved sit-and-reach performance was not unexpected. Again, given the dynamic nature of the exercise, including level changes and both static and dynamic movements, improved hip and lower-back flexion was expected and consistent with the findings of other studies in which flexibility was targeted through specific exercises (2).

Perceptions of physical functioning, pain, and vitality were all significantly improved following training. As far as physical functioning is concerned, there appears to be a relationship between function and mobility, particularly walking speed (3). Therefore, it is logical to conclude that improved mobility was associated with a high degree of physical functioning. Similarly, subjects in this study appeared to perceive less pain and feel more vital following 12 weeks of exposure to a functional exercise circuit. Finally, a reduction in the number of doctor visits would seem to go hand in hand with improved mobility as well as a reduction in pain and a feeling of more vitality. Other investigators have reported that older adults who report a high level of physical functioning also perceived themselves as being healthy (21). Hence, such subjects are less apt to make scheduled visits to their doctor.

This study offers support for using a functional exercise circuit as a safe and cost-effective alternative to traditional exercise interventions for older adults. Subjects did appear to derive both functional and perceived health benefits from their participation in the functional exercise circuit. Clearly, these findings must be interpreted with caution. Without an experimental investigation, we may not conclude a cause-and-effect relationship. However, considering the adherence rate of 83% and the fact that no subjects sustained injury during the course of the study, the functional exercise circuit did appear to be suitable for older adults. Future investigations should focus on comparing a traditional exercise intervention with the functional exercise circuit.

**PRACTICAL APPLICATIONS**

A practitioner may find that a functional exercise circuit can be both challenging and beneficial for an elderly subject wishing to improve physical functioning and mobility. In addition, because the functional exercise circuit includes a series of movement patterns that must be produced under varying conditions (i.e., space negotiations, directional changes, level changes), the subject is afforded cognitive stimulation. Still, it is unclear at this time whether better results could be expected from a functional exercise circuit like the one employed here when compared to traditional exercise interventions. Nevertheless, considering that none of the subjects in this study was injured and that the participation is both time- and cost-effective, it seems logical to consider a functional exercise circuit an alternative form of exercise for older adults.

**REFERENCES**


Acknowledgments
This study was supported by a grant from the Quantum Foundation, Inc., West Palm Beach, Florida.

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