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Long-Term Maintenance of Physical Function in Older Adults Following a DVD-Delivered Exercise Intervention

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Abstract

Background—Previous evidence suggests physical activity interventions effectively produce short-term improvements in physical function for older adults. The present study examined whether improvements in physical function after a DVD-delivered exercise intervention were maintained 18 months post-intervention.

Methods—Older adults ($n = 153$) randomized to a six-month DVD-delivered exercise intervention or an attentional control condition were contacted 18-months post-intervention. Participants completed the Short Physical Performance Battery (SPPB) and measures of flexibility, strength, and functional limitations. Analyses of variance were conducted to determine if improvements in physical function as a result of the intervention were maintained at follow-up.

Results—Improvements in the SPPB, $F(1,125) = 3.70$, $p = .06$, $\eta^2 = .03$, and upper body strength, $F(1,121) = 3.04$, $p = .08$, $\eta^2 = .03$ were maintained for the intervention condition.

Conclusions—Home-based DVD exercise training interventions may hold promise for long-term maintenance of physical function in older adults.

Introduction

Physical activity has been repeatedly demonstrated to be beneficial for improving physical function in older adults (CDC, 2013). However, most of this research has reported short-term effects (i.e. end of intervention) with little emphasis on the capacity for these effects to be maintained in the long-term (Rejeski et al., 2009). Maintaining physical function throughout the aging process is vital for living independently, preserving quality of life, and overall successful aging. Center-based physical activity interventions have effectively improved physical function and reduced disability, however, they are often costly and limited in reach (Glasgow et al. 2002). Thus, there is a need to identify physical activity programs that can be more effectively delivered to a large number of individuals that allow continued participation post-intervention to ensure effects of the exercise program are maintained long after study personnel support has ended.

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McAuley and colleagues (2013) designed a home-based exercise training program delivered by DVD targeting flexibility, strength, and balance (i.e., *FlexToBa*). Initial findings indicated the intervention condition showed both statistically and clinically significant improvements on the Short Physical Performance Battery (SPPB; Guralnik et al., 1994), upper body strength, and lower body flexibility relative to an attention control DVD condition (McAuley et al., 2013). In large part, these gains following the intervention were maintained at a six-month follow-up assessment (Wójcicki et al., 2015). The objective of the present study was to determine whether improvements in physical function brought about by the six-month DVD-delivered exercise intervention were maintained 18 months beyond intervention termination.

Methods

Study design and intervention

Details of the study design, delivery, and eligibility criteria are available elsewhere (McAuley et al., 2013; Wójcicki et al., 2015). Briefly, low-active community-dwelling older adults were recruited from a 5,000 square mile radius of east-central Illinois to participate in a study examining the effects of a six-month exercise program on functional performance. Participants meeting all eligibility criteria (N=307) were randomized to either the *FlexToBa* DVD condition (n=158) or an attentional control healthy aging DVD condition (n=149). Participants in the *FlexToBa* intervention were provided with exercise equipment (i.e. yoga mat, two resistance bands varying in resistance) and a six-month, DVD-delivered exercise training program consisting of 11–12 flexibility, strengthening, and balance exercises per session. Over the course of the intervention, exercises increased in difficulty and complexity.

Participants assigned to the attentional control condition were provided with Dr. Andrew Weil's Healthy Aging DVD in which a variety of health topics related to successful aging are discussed (Brown, 2006). Both conditions received titrated support calls across the intervention period. Follow-up measures of functional performance and limitations were assessed 24 months after baseline assessment. This study was approved by the Institutional Review Board at the university.

Primary Outcome Measures

Functional Performance

To measure functional performance, the Short Physical Performance Battery (SPPB; Guralnik et al., 1994) was administered by trained research staff. The SPPB measures balance, gait speed, and lower extremity strength. Total SPPB scores range from 0–12 and were calculated by summing the scores from each component. Higher scores correspond with better functional performance. Additional domains of physical function, upper body strength and endurance as well as upper and lower body flexibility, were assessed using three elements of the Seniors Fitness Test (Rikli & Jones, 1999); the 30-second arm curl, back scratch, and sit and reach test.

Functional Limitations

The abbreviated version (McAuley et al., 2005) of the Late-Life Function and Disability Instrument (Haley et al., 2002) was used to assess functional limitations. Participants responded to 16 questions on a 5-point Likert scale to report their degree of difficulty completing everyday tasks. Specific items are categorized into one of three subscales; upper-extremity function and basic and advanced lower-extremity function. A total limitation scale is derived by summing the three subscales with higher scores reflecting fewer limitations.

Data Analysis

Chi-square and t-tests determined whether participants who completed follow-up assessments differed from those who did not in terms of age, gender, race, education, marital status, and income. In order to determine whether the *FlexToBa* intervention effects reported at six months (McAuley et al., 2013) were maintained at 18 months post-intervention, a series of mixed model analyses of variance (ANOVA) were conducted. A maintenance effect would be supported by a significant main effect for condition which favored the *FlexToBa* group. In each analysis, condition was the between group factor and time (i.e. 6 and 18 month values of functional performance and limitations) was the within subject factor. One outlier was Winsorized to ± 3.0 standard deviations. Analyses were run again with baseline values for each function measure and age were entered as covariates. Effect sizes were expressed as partial η^2 . All analyses were conducted in SPSS 22 (IBM Corp., Armonk, NY).

Results

Of the 307 participants who consented to the study, 129 (42%) completed functional performance measures 153 completed the functional limitations measure (~50%) at 24-month follow-up. There were no significant demographic differences between participants who completed follow up assessments and those who did not (all p s > .2), with the exception of age ($p = .02$) which was associated with being less likely to complete follow-up assessments. Participant characteristics are summarized in Table 1.

SPPB

The mixed model ANOVA revealed a significant main effect for group for the SPPB, ($F(1, 127) = 7.12, p = .01, \eta^2 = .05$). After adjusting for baseline values and age, the group difference approached significance, ($F(1, 125) = 3.70, p = .06, \eta^2 = .03$). As can be seen in Tables 2 and 3, participants in the *FlexToBa* condition have SPPB scores at 24 months that remain above baseline values whereas the control condition scores declined over time. This difference at 24 months is in the range for a small clinically significant improvement (Kwon et al., 2009).

Upper Extremity Strength

The groups differed in upper body strength at 24 months, ($F(1, 124) = 7.461, p = .01, \eta^2 = .06$) indicating the *FlexToBa* condition maintained improvements in strength over time compared to the control condition (Table 2 and 3). This maintenance effect approached significance after adjusting for covariates, ($F(1, 121) = 3.04, p = .08, \eta^2 = .03$).

Flexibility

Neither group differed significantly in upper body flexibility ($F(1,120) = 2.219, p = .14, \eta^2 = .02$) or lower body flexibility scores with no significant differences between conditions ($F(1,123) = .23, p = .63, \eta^2 = .00$).

Functional Limitations

Participants' perceived functional limitations did not differ between groups, ($F(1,147) = .43, p = .51, \eta^2 = .00$).

Discussion

In the present study, we determined whether gains in function performance brought about by a six-month, DVD-delivered exercise intervention (McAuley et al., 2013) were maintained at 18-month follow-up. The primary outcome was the SPPB (Guralnik et al., 1994), an important clinical determinant of subsequent institutionalization, morbidity, and mortality (Guralnik et al., 2000). Participants in the *FlexToBa* intervention maintained a clinically meaningful improvement (Kwon et al., 2009) in SPPB performance compared to the control condition. This is an important finding in that clinical gains in mobility and balance can be achieved by a DVD-delivered intervention and improvements over baseline can be maintained two years later. One large exercise trial targeting the improvement of functional outcomes in older adults at risk for disability produced similar outcomes (Pahor et al., 2006). A sub-sample of participants from the Lifestyle Interventions and Independence for Elders Pilot (LIFE-P; Rejeski et al., 2009) completed the SPPB 24 months after a 12-month intervention. Older adults in the physical activity intervention had higher SPPB scores at 24 months (effect size = .40; $p = .052$) than a successful aging control condition. Thus our findings are comparable to the LIFE-P outcomes and we are optimistic regarding the potential for broad scale improvements in physical function via a low-cost, unsupervised, structured exercise program for older adults.

Although improvements in upper body strength favoring the *FlexToBa* condition were maintained at 24 months, neither condition differed in their levels of flexibility or self-reported functional limitations. It has also been argued that balance and strength are perhaps more valuable for physical functioning than flexibility (Toraman & Yildirim, 2010). For example, leg strength, agility, balance, but not flexibility have been associated with fall risk (Toraman & Yildirim, 2010). Further, the lack of any effect on perceived functional limitation effects may be indicative of two factors. First, our sample, in general, was inactive but otherwise relatively healthy with baseline SPPB scores that suggested the participants were not at risk for frailty. The second factor concerns age; those participants available and willing to test at long-term follow-up were significantly younger than those who did not complete follow-up measures. As such, one might expect a younger group to have fewer functional limitations.

There are several strengths to the present study, as previously noted (McAuley et al., 2013; Wójcicki et al., 2015). Using a DVD to deliver an exercise training intervention that is efficacious, innovative, relatively inexpensive, and has considerable potential for broad

dissemination and scalability. Providing an exercise intervention that is accessed at home rather than requiring participants to attend center based sessions may enhance independence and reduce barriers common to older adults (e.g., transportation, fear of exercising in group setting). Including age-matched models demonstrating challenging and modified versions of each exercise, accompanied with the varying resistance bands, allows participants of varying functional capabilities to engage in the same exercise intervention, without the pressure of following along with a group at a center-based program. Finally, few studies have demonstrated the long-term effectiveness of interventions, especially 18-months after the intervention end. This is a major strength of this study. From a limitations perspective, the majority of our sample were well educated, healthy, white females, and earned an income of \$40,000 annually. While these characteristics reflect a common trend among samples of older adults, future studies should target more diverse socioeconomic and demographic samples. Additionally, we were only able to test ~40% of the original sample thus reducing statistical power.

In conclusion, the *FlexToBa* exercise intervention resulted in significant and clinically meaningful improvements in physical function which were largely maintained 24 months post-baseline. These are encouraging findings and support the efficacy of this exercise training program as a useful alternative to center-based programs that may present barriers to participation in older adults who could benefit from improved physical function. These findings have significant public health implications given the potential for widespread dissemination and the capacity to provide long-lasting improvements in function for older adults.

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Table 1

Participant characteristics at follow up.

Measure	FTB (n = 84)	Control (n = 69)
Age (Mean, SD)	70.01 (4.98)	70.72 (4.59)
Sex (n, %)		
Female	61 (72.6)	55 (79.7)
Male	23 (27.4)	14 (20.3)
Race (n, %)		
Non White	3 (3.6)	4 (5.8)
White	81 (96.4)	65 (94.2)
Education (n, %)		
Non-College Graduate	38 (45.2)	43 (62.3)
College Graduate	46 (54.8)	26 (37.7)
Marital Status (n, %)		
Married/partnered	54 (64.3)	36 (47.8)
Single,divorced, widowed	30 (35.7)	33 (52.2)
Income (n, %)		
<\$40,000	36 (42.9)	37 (53.6)
\$40,000	48 (57.1)	32 (46.4)

Note: FTB = FlexToBa

Table 2

Unadjusted function outcomes

	FTB mean (SD)	Control mean (SD)
SPPB		
Month 0	10.49 (1.22)	10.45 (1.30)
Month 6	10.91 (1.02)	10.37 (1.56)
Month 24	10.76 (1.09)	10.28 (1.67)
Arm Curls		
Month 0	13.92 (3.87)	13.12 (3.21)
Month 6	14.99 (4.43)	13.56 (3.55)
Month 24	15.24 (4.65)	13.81 (3.70)
Back Scratch		
Month 0	−3.83 (5.20)	−2.82 (4.89)
Month 6	−2.75 (4.70)	−2.88 (4.44)
Month 24	−2.96 (5.39)	−3.11 (4.68)
Sit and Reach		
Month 0	−.08 (3.31)	−.11 (3.88)
Month 6	−.10 (3.73)	−.99 (4.21)
Month 24	.58 (3.51)	.47 (3.36)
LL FDI		
Month 0	63.10 (7.25)	62.47 (7.92)
Month 6	65.28 (6.90)	63.76 (6.87)
Month 24	64.04 (7.68)	62.91 (9.31)

Note: FTB = FlexToBa.

Table 3

Function outcomes, adjusted for baseline values and age.

	FTB mean (SE)	Control mean (SE)	<i>P (group difference)</i>
SPPB			.06
Month 6	11.06 (.91)	10.57 (1.11)	
Month 24	10.76 (1.09)	10.28 (1.67)	
Arm Curls			.08
Month 6	15.57 (4.45)	13.75 (3.18)	
Month 24	15.14 (4.07)	13.82 (3.56)	
Back Scratch			.14
Month 6	-2.48 (5.00)	-2.66 (4.11)	
Month 24	-2.81 (5.33)	-2.82 (4.50)	
Sit and Reach			.63
Month 6	-.16 (3.97)	-.68 (3.20)	
Month 24	.54 (3.53)	.47 (3.36)	
LL FDI			.51
Month 6	65.98 (7.05)	64.65 (6.56)	
Month 24	63.93 (7.75)	62.91 (9.31)	

Note: FTB = FlexToBa.