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Physical Activity Levels and Patterns in Older Adults: The Influence of a DVD-Based Exercise Program

Neha P. Gothe^{1,*}, Thomas R. Wójcicki¹, Erin A. Olson¹, Jason Fanning¹, Elizabeth Awick¹, H. David Chung¹, Krystle E. Zuniga¹, Michael J. Mackenzie¹, Robert W. Motl¹, and Edward McAuley¹

¹Department of Kinesiology and Community Health, University of Illinois at Urbana-Champaign

Abstract

The use of multimedia to influence health behaviors offers unique advantages over more traditional center-based programs, however, little is known about the effectiveness of such approaches in improving physical activity levels over time. The purpose of this study was to examine the efficacy of a progressive and age-appropriate, DVD-delivered exercise program in promoting physical activity levels among older adult cohorts. Community dwelling older adults (N=307, Mean age=71 years) were randomized to one of two groups: a 6-month home-based DVD-delivered exercise program i.e. the *FlexToBa* intervention group or a healthy aging DVD control group. Physical activity was assessed objectively using a standard 7-day accelerometer wear period and subjectively using the Godin Leisure Time Exercise Questionnaire, at baseline and follow-up. ANCOVAs indicated a statistically significant treatment effect for subjectively [$F(1,250) = 8.42, P = .004, \eta^2 = .03$] and objectively [$F(1,240) = 3.77, P = .05, \eta^2 = .02$] measured physical activity. The older cohort (>70) in the *FlexToBa* condition further had significantly larger improvements in physical activity levels compared to their younger counterparts. From a public health perspective, media-delivered interventions such as the *FlexToBa* program might prove to be cost-effective, have a broader reach and at the same time be effective in improving physical activity levels in older adults.

Keywords

DVD-delivered exercise; physical activity; accelerometer; home-based program

Introduction

Leading a physically active lifestyle is of critical importance to lowering rates of all-cause mortality (Nocon, et al., 2008), preventing non-communicable diseases (Lee, Shiroma,

Corresponding Author: Edward McAuley PhD, Department of Kinesiology and Community Health, University of Illinois at Urbana Champaign, 906 S. Goodwin Ave, Urbana, IL 61801, emcauley@illinois.edu, Tel: 217-333-6487, Fax: 217-244-7322. Alternate Corresponding Author/Present address: Neha P. Gothe PhD; Department of Kinesiology, Health and Sport Studies, 266 Matthaei Bldg, Wayne State University, Detroit, MI-48202, nehagothe@wayne.edu, Tel: 313-577-6222.

Conflict of Interest

Neha P. Gothe, PhD, Thomas R. Wójcicki, PhD, Erin A. Olson, PhD, Jason Fanning, MS, Elizabeth Awick, MS, H. David Chung, MS, Krystle E. Zuniga, PhD, Michael J. Mackenzie, PhD, Robert W. Motl, PhD, and Edward McAuley, PhD, declare that they have no conflict of interest.

Lobelo, Puska, Blair, & Katzmarzyk, 2012; Owen, Bauman, & Brown, 2009), and maintaining functional independence in later life (Hall & McAuley, 2011; Keysor, 2003; Pahor et al., 2007). As a result, health organizations around the world have delineated age-specific guidelines and recommendations for physical activity as it relates to health (HHS, 2008; WHO, 2010).

Physical activity guidelines for older adults recommend the accumulation of at least 150 minutes of moderate intensity physical activity over the course of the week in order to obtain health-related benefits. Additionally, occasional participation (i.e. 2–3 days per week) in muscle strengthening and balance-based activities should be regularly incorporated to minimize the risk of falls (Chang et al., 2004) and preserve or improve functional fitness (Peterson et al., 2010). The creation of such guidelines highlights the importance of regularly engaging in physical activity for the improvement and/or maintenance of health and function. However, objective physical activity data collected from the National Health and Nutrition Examination Survey (Tucker, Welk, & Beyler, 2011) suggest that 8.5% of older American adults aged 60–69 years met the moderate physical activity guidelines, while only 6.3% of adults aged 70 years and greater did so. Clearly, there is a need for researchers and public health officials alike to intervene and create physical activity programs specifically targeted at and designed for older adults.

Although several exercise interventions have been successful in increasing physical activity in older adults, these improvements are often small and transient (Pahor et al., 2007; van der Bij, Laurant, & Wensing, 2002). Moreover, most interventions utilize center-based exercise training programs which are typically costly, resource intensive, require participants to travel, and have limited reach and generalizability. Therefore, novel approaches that adequately address or at the very least minimize these limitations are needed to better assist older adults in the adoption and maintenance of a physically active lifestyle.

Multimedia approaches can serve as a useful delivery and dissemination method for health behavior programs, as they possess the potential to promote successful aging via the provision of expert-delivered, age-appropriate content. One form of multimedia technology that can be particularly useful for improving physical activity behavior in older adults is the DVD (McAuley et al., 2013). Recent data show that older adults represent roughly one fifth of the commercial exercise DVD market (Kaczanowska, 2012), suggesting that this demographic is both familiar with and capable of using this technology. Additionally, older adults appear to be willing to adopt new technologies that support health and independence, as long as issues of usability, reliability, privacy, and affordability, are all adequately addressed prior to public dissemination (Coughlin D'Ambrosio, Reimer, & Pratt, 2007; Heinz et al., 2013). Delivering a theoretically-based exercise program specifically designed for older adults via DVD could overcome many potential limitations that are often associated with center-based trials and, if effective in changing behavior, could have a significant public health yield.

In this study we report findings from a 6-month randomized controlled exercise trial in which we examine the effects of a DVD-delivered exercise intervention on subjectively and objectively measured physical activity in a sample of older adults. It was hypothesized that

participation in the exercise condition would increase total daily physical activity levels in comparison to an attentional control group, and that both measures of physical activity would provide similar results regarding changes in patterns of physical activity. In addition, we were interested in determining whether the intervention differentially affected younger and older participants within the sample (i.e. those ≤ 70 years and those > 70 years). Given that older individuals are less active, we hypothesized that those > 70 years of age would be more likely to increase their activity levels relative to their younger counterparts.

Methods

Participants

Details regarding recruitment, intervention content and program delivery have been reported elsewhere (McAuley et al., 2012; McAuley et al., 2013). Figure 1 presents the flow of participants through the *FlexToBa* trial (McAuley et al., 2013). Briefly, participants ($N = 307$) were low-active (≤ 2 days/week of physical activity lasting at least 30 minutes for the past 6 months) community-dwelling older adults recruited to participate in a 6-month, home-based, DVD-delivered exercise program focusing on flexibility, toning, and balance (*FlexToBaTM Trial*). Participants were randomized into one of two conditions: 1) the *FlexToBa* intervention in which participants were encouraged to exercise with the exercise DVD every other day; 2) an attentional control condition in which participants were given the commercially available “Healthy Aging” DVD by Dr. Andrew Weil. Both groups were contacted by the research staff for the same frequency and duration of time. Physical activity assessments were collected at baseline and again following program completion (i.e. month 6).

Measures

Godin Leisure Time Exercise Questionnaire (GLTEQ)—Participants completed the Godin Leisure Time Exercise Questionnaire (Godin & Shepard, 1985). The GLTEQ assessed the number of times per week an individual performs strenuous, moderate, and mild exercise for more than 15 minutes during free time. The weekly frequencies of strenuous, moderate, and light activities were multiplied by their respective METs of 9, 5, and 3, and then summed to obtain the weekly leisure time score (possible range = 0–119).

Accelerometry—The Actigraph accelerometer (Actigraph, Pensacola, FL; Model GT1M or GT3X) was used as an objective measure of physical activity. The accelerometer was secured on an elastic belt and participants were instructed to wear the monitor on their non-dominant hip for 7 consecutive days. Participants were asked to record the times the monitor was worn each day on a log (i.e. time the monitor was put on upon waking and taken off at bedtime) for the purpose of distinguishing between device wear time and non-wear time. The interruption period was set to 30 minutes and participants with a minimum of 3 days with ten valid hours of wear time were included in the analyses (Mailey et al., 2013). Once downloaded, data were scored using MeterPlus version 4.2 (Santech, Inc.; San Diego, CA) and displayed as activity counts, which reflect raw accelerations that have been digitized, converted, and summed over a specified epoch length (e.g., 1 minute). These activity counts are directly related to physical activity intensity. We used the accelerometer-count cut points

as defined by Copeland and Eslinger (2009), which were specifically developed for older adults. The cut point defining moderate to vigorous physical activity (MVPA) was 1,041 counts/min.

Interventions

Briefly, participants in the *FlexToBa* condition received an expertly designed and professionally developed set of exercise DVDs specifically aimed at improving physical function in older adults. The series contained a total of six exercise sessions that progressively increased in both complexity and physical demands. Each session was designed to be completed over the course of four weeks before advancing to the next set of exercises, and participants were asked to exercise with the DVD every other day. Each exercise session contained two sets of 11–12 different exercises focusing on balance, strength, and flexibility. Participants were provided with a yoga mat, two resistance bands (one of light and one of moderate intensity), and a *FlexToBa* handbook based on the social cognitive theory emphasizing self-regulation, goal-setting and addressed common barriers to exercise. Detailed verbal and visual instructions were provided for each exercise, along with two modified versions (i.e. more or less challenging) to better accommodate varying levels of functional fitness and individual progress and/or setbacks. Participants were asked to complete and mail in daily exercise logs on a monthly basis in order to receive personalized program feedback and received regular support calls with exercise tips from the research staff.

Participants in the attentional control condition received a commercially available DVD (“Dr. Andrew Weil’s Healthy Aging”) that focused on older adults leading a healthy lifestyle. Participants were asked to watch the healthy aging DVD in its entirety, and they also received regular support calls that shared the same timeline as the *FlexToBa* condition. On average, the support calls lasted less than five minutes in duration and were biweekly for the first two months and monthly thereafter. These were used to provide generic tips on healthy aging for the control group (e.g., “Stay connected intellectually and socially to those around you. Choose something you enjoy. This could mean going out with friends or family, joining a club, or even volunteering”) and exercise-specific recommendations for the *FlexToBa* condition (e.g., “Simple cues such as laying your exercise clothes out the night before or scheduling your workouts on your calendar can help keep you on track towards maintaining or increasing your physical activity”).

Data Analysis

We used IBM SPSS Statistics (Version 20.0. Armonk, NY: IBM Corp.) to conduct all analyses. Data from participants who completed both the baseline and follow-up assessments were analyzed ($N = 256$, 83.33% see McAuley et al. 2013 for a CONSORT). There were 18.6% missing data for the accelerometer (22% for the *FlexToBa* condition and 14.8% for the Healthy Aging DVD condition) and 16.6% missing for the GLTEQ (22% for *FlexToBa* and 10.7% for the Healthy Aging DVD condition). Independent samples t-tests were conducted to determine whether there were any baseline differences on the physical activity variables. A median split was used to create the two age categories: participants aged 70 and younger ($N = 150$, $M_{age} = 67.3 \pm 1.7$), and participants aged 71 and older ($N =$

106; Mage = 75.5±3.9). Analysis of covariance (ANCOVAs) models were used to investigate treatment and age group effects at follow-up, controlling for sex and respective baseline physical activity scores.

Results

Demographic Characteristics

Table 1 summarizes the demographic characteristics of the participants by intervention and age group. There were no significant differences between the two conditions at baseline (all P values > .05).

Intervention effects on the Physical Activity Outcomes

Table 2 shows the intervention effects on the GLTEQ score and accelerometer MVPA counts for the *FlexToBa* and control treatments by age categories for the two time-points. There were no significant differences between the *FlexToBa* and control scores at baseline on the two outcomes. For accelerometer measured MVPA, there was a significant age group difference where young adults showed higher levels of baseline MVPA as compared to the older adults ($p < .05$).

The ANCOVA for the GLTEQ score showed a significant treatment effect [$F(1,250) = 8.42$, $P = .004$, $\eta^2 = .03$] and no age group $\times$ treatment interaction was observed [$F(1,250) = .63$, $P = .43$]. As seen in Table 2, both the young and older adults in the *FlexToBa* condition reported significantly higher levels of physical activity at follow up (approximately a 10 point increase on the GLTEQ score for both age groups) whereas the control participants showed smaller changes at follow up (only .4 for the control-young and 3 for control-old).

The ANCOVA for accelerometer MVPA counts showed a significant treatment effect [$F(1,240) = 3.77$, $P = .05$, $\eta^2 = .02$] and a significant age group effect [$F(1,240) = 4.45$, $P = .03$, $\eta^2 = .02$]. As seen in Table 2, the *FlexToBa* participants engaged more time in MVPA at follow up (approximately 7 minutes/week increase for the *FlexToBa*-young and a 46 minutes/week for *FlexToBa*-old) whereas the mean physical activity level of control participants, young and old declined (approximately 9 and 37 minutes/week respectively). The age group effect was in the expected direction with the *FlexToBa*-old engaging in higher levels of MVPA compared to their younger counterparts at follow-up.

Discussion

The purpose of this study was to examine the efficacy of a DVD-delivered exercise program in promoting physical activity levels among two cohorts of older adults. Overall, the *FlexToBa* intervention was successful in improving physical activity levels in a sample of older adults with oldest participants appearing to improve the most.

As expected, participants in the older cohort in this trial were less physically active at baseline as compared to their younger counterparts. This trend was observed on the self-report questionnaire as well as objectively assessed physical activity using accelerometers, reinforcing the need to design and implement unique exercise programs for the oldest old.

When aligned with recommendations formulated by the Surgeon General (HHS 2008), and the dose-response relationship between the volume of physical activity and health benefits, the GLTEQ scores of participants in the *FlexToBa* group represent moderate to substantial health benefits at follow up (Godin, 2011). Although Godin (2011) bases these health benefits on scores derived from only moderate and vigorous activities, we include light activity in calculating the GLTEQ composite score for this study. For many older adults, especially the ‘old’ groups in our study, even light activity can be quite exerting, leading to health benefits (Buman et al., 2010).

Contemporary approaches to physical activity promotion such as the DVD-based *FlexToBa* program may offer unique advantages over traditional center-based programs and might work toward empowering older adults to independently and successfully adopt healthy lifestyles. This program is comprised of progressive and modifiable sessions which are simple to follow and make use of affordable and widely available equipment such as hand weights or resistance bands. The DVD nature of the intervention also allows for wider reach and dissemination potentially resulting in a greater public health impact when compared to traditional site-based interventions that promote physical activity. Such home-based interventions circumvent age specific barriers for older adults such as physical environment and transportation (Schutzer & Graves, 2004). Our results not only highlight the success of this novel intervention but also that the older adults felt safe and capable of effectively executing the program within the comfort of their own homes (McAuley et al., 2013).

There are a number of strengths and limitations to this work. As previously noted (McAuley et al., 2013), a majority of the sample consisted of Caucasian women. The efficacy and adherence to such a DVD-based exercise program remains to be determined among older adults belonging to minority groups. Although no gender differences were observed in the current study, future work might examine how gender attitudes toward physical activity may influence the adoption, participation, and continued maintenance of physical activity. The clinical significance of this work lies in the fact that a carefully designed, progressive and modifiable DVD-delivered exercise program can be well received and easily implemented in the community to improve physical activity levels among community dwelling older adults, especially those over 70 years. Such novel, cost effective and easily distributable programs have the potential to be successful in improving physical activity among older adults thereby impacting morbidity, disability and quality of life in old age. Indeed the DVD approach to physical activity delivery may serve as a foundation to other more contemporary multimedia delivery systems (e.g., streaming video). It is also important to conduct effectiveness trials using the *FlexToBa* DVD to test the adoption and engagement in physical activity in the absence of any support or feedback from the research staff. As the *FlexToBa* intervention was a 6-month long program, future research necessitates longer follow up time-points that will enable researchers to determine the adherence and maintenance of a healthy active lifestyle outside of the intervention period. Additionally, effectiveness trials are required to test the sustainability of such programs in community dwelling populations.

In summary, this study provides evidence for a home-based, media-delivered exercise intervention that led to significant improvements in physical activity levels among older adults. The *FlexToBa* exercise program was not only effective in improving functional

outcomes (McAuley et al., 2013) but also led to significant improvements in older adults' physical activity levels. These findings are critical from a public health perspective as media-delivered interventions such as the *FlexToBa* program might prove to be cost-effective, provide a wide reach and at the same time be successful in improving physical activity and functional performance among older adult populations. The findings also highlight the need to study different age cohorts among older adults to identify unique subgroups and implement targeted programs to promote physical activity, in turn promoting functional independence and better quality of life.

Human Subjects

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000 (5). Written informed consent was obtained from all participants for being included in the study.

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Figure 1.
Flow of Participants Through the *FlexToBa* Trial (CONSORT originally published in *Journals of Gerontology - Series A: Biological Sciences and Medical Sciences*, see McAuley et al. 2013)

Table 1Participant Characteristics for *FlexToBa™* and Control Conditions

Measure	FTB (n = 158)	Control (n = 149)	FTB Young (n = 96)	Control Young (n = 74)	FTB Old (n = 62)	Control Old (n = 75)
Age, mean (SD)	70.62 (0.40)	71.43 (0.43)	67.34 (1.62)	67.34 (1.82)	75.69 (4.20)	75.47 (4.31)
Sex, n (%)						
Female	113 (71.5)	123 (82.6)	67 (69.8)	63 (85.1)	46 (74.2)	60 (80.0)
Male	45 (28.5)	26 (17.5)	29 (30.2)	11 (14.9)	16 (25.8)	15 (20.0)
Race, n (%)						
African American	2 (1.3)	4 (2.7)	1 (1.04)	2 (2.7)	1 (1.6)	2 (2.7)
Asian	2 (1.3)	1 (0.7)	2 (2.09)	0 (0.0)	0 (0.00)	1 (1.4)
Native American	1 (0.6)	0 (0.00)	1 (1.04)	0 (0.0)	0 (0.00)	0 (0.0)
White	153 (96.8)	144 (96.6)	92 (95.8)	72 (97.3)	60 (98.4)	71 (96.0)
Education, n (%)						
Non-College Graduate	90 (57.0)	82 (55.0)	49 (49.0)	43 (58.1)	21 (33.9)	39 (52.0)
College Graduate	68 (43.0)	67 (45.0)	47 (51.0)	31 (41.9)	41 (66.1)	36 (48.0)
Annual Income *, n (%)						
\$40,000	46 (34.1)	51 (40.2)	34 (35.4)	29 (39.2)	35 (56.5)	44 (58.7)
> \$40,000	89 (65.9)	76 (59.8)	62 (64.6)	45 (60.8)	27 (43.6)	31 (41.3)

Note: FTB - *FlexToBa*;

* frequencies may not sum to group totals due to missing data

Table 2

Means and Standard Deviations of the Physical Activity Variables by Treatment and Age Group across Time-Points

	Accelerometer MVPA			
	GLTEQ score		Month 6	
	Baseline	Month 6	Baseline	Month 6
FlexToBa group	14.56 ± 19.2	23.48 ± 19.9	228.83 ± 176.8	234.67 ± 185.6
FlexToBa - young	15.66 ± 21.4	24.75 ± 19.7	250.52 ± 182.6	257.67 ± 197.9
FlexToBa - old	11.84 ± 12.2	21.02 ± 20.2	147.37 ± 133.1	193.39 ± 154.7
Control group	15.36 ± 19.9	17.24 ± 17.2	244.09 ± 259.0	200.81 ± 177.4
Control - young	16.11 ± 21.7	16.54 ± 16.4	266.85 ± 246.7	257.28 ± 204.5
Control - old	14.21 ± 16.9	17.99 ± 18.1	185.56 ± 238.4	148.63 ± 137.2
Change scores				
FlexToBa group	8.92 ± 21.25		5.85 ± 155.18	
FlexToBa - young	8.22 ± 22.18		-10.13 ± 154.14	
FlexToBa - old	10.29 ± 19.51		34.52 ± 154.65	
Control group	1.88 ± 18.78		-43.28 ± 232.52	
Control - young	.25 ± 21.41		-33.25 ± 247.56	
Control - old	3.63 ± 15.45		-53.98 ± 216.93	