

Functional Performance in Older Adults after a Combination Multicomponent Exercise Program and Bingo Game

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ABSTRACT

International Journal of Exercise Science 8(1) : 38-48, 2015. Inexpensive exercise interventions are needed to attract and retain older adults to participate in sufficient amounts of exercise to improve functional performance (FP). This study examined the addition of a program enhancing game, bingo, to a multicomponent exercise program (Bingocize™). Older adults (18 women, *M* age = 75.1 (8.63) years, participated 2 days per week (45- 60 minute sessions) for 10 weeks. Participants sat at tables with bingo cards, balance pads, and exercise bands. Exercises were alternated with rolls of bingo until a participant won the bingo game. Pre and post body weight (BW), body mass index (BMI), and FP were measured. FP was assessed using the Senior Fitness Test battery. Using paired-sample *t*-tests, significant improvements were found in all FP measures, but not in BW or BMI ($p < .05$). The low-cost, sustainability, and ease of implementation suggest Bingocize™ may be a novel and enjoyable alternative to traditional older adult group exercise interventions. Our results should be interpreted with caution due to the lack of a control group and small sample size. Future research could examine changes in activities of daily living, quality of life, and other measures of functional fitness in this and other populations.

KEY WORDS: Exercise training, intervention, elderly, chronic disease

INTRODUCTION

Older adults experience declines in muscle mass (sarcopenia), bone-mineral density, muscle strength and endurance, cardiorespiratory fitness, balance, and flexibility (7). Together, these contribute to loss of functional performance (FP) or the capacity to perform normal everyday activities safely and independently without fatigue (28). Decreases in FP may lead to an

increased risk of injurious falls and reduced ability to perform activities of daily living (ADLs). Toraman and colleagues (35) determined that multicomponent (cardiorespiratory fitness, muscular strength, flexibility) exercise is a safe and effective strategy to improve FP. Despite the demonstrated benefits, older adults report real and perceived exercise barriers that result in only 15% of adults 65 years and older meeting the guidelines for

participating in regular physical activity to enhance cardiorespiratory fitness and muscular strength (6). This dismal participation has led researchers to design exercise interventions that can improve older adults' adherence with the hope of improving FP. One strategy to improve adherence in older adults is the inclusion of *program enhancers*, which keeps the program fun and interesting for the participants. Examples include music, options for activities, and the use of specialized equipment (34).

More recently, electronic games or *exergaming* (virtual reality, video games) have been used as a program enhancer to increase physical activity, improve cognition, and improve balance, gait, and aerobic capacity (1, 16 18, 24, 31). Although successful, many older adult facilities, especially those serving lower income older adults, are unable to purchase the specialized equipment required for exergaming due to cost constraints. Including all interested participants in these types of games due to limited equipment availability may also limit participation. Utilizing lower cost games that older adults have commonly enjoyed and regularly participated may be a novel and cost effective way to entice older adults to exercise. One such game that is popular among the older population is bingo. Government funded senior housing facilities, assisted living facilities, senior citizen community centers, and nursing homes currently host bingo games, making equipment and willing participants readily available (33). Bingo has been used to successfully increase social engagement and cognitive performance in older adults with Parkinson's and Alzheimer's Diseases

(21). It has also been used to increase older adults' knowledge about their risks of medication and interactions (4). To our knowledge, the game of bingo has not been examined as a program enhancer to attract and retain older adults in an exercise intervention. Therefore, the purpose of this study was to determine if participation in a multicomponent exercise program that included a program enhancer (bingo) could significantly improve FP in older adults.

METHODS

Participants

Community-dwelling older adults residing at two federally subsidized older adult facilities were considered for the study. These facilities were chosen because of their close proximity to the Kentucky Wesleyan College (KWC) campus in which participants had similar demographic, socioeconomic, and health status. Participants were recruited using posted flyers, newsletters, and verbal communication. Inclusion criteria were: participants must be 55 years of age or older, have no cognitive deficiencies that would preclude them from giving informed consent, physician's release, no orthopedic limitations, be healthy enough to participate in exercise, and not currently a part of a formal resistance or cardiovascular training program. Two weeks prior to the start of the investigation two informational sessions were conducted at each facility. The initial sessions were used to explain the purpose of the investigation and establish the requirements of the exercise sessions. There were no gender limitations in recruitment. Eighteen women (11 from facility 1; 7 from facility 2) met the inclusion criteria. Participants were predominately

Table 1. Description of senior fitness tests.

	Description	Measured Construct
Chair Stand Test	Number of stands from a chair in 30 seconds	Lower-body muscular strength/power
Arm Curl Test	Number of arm curls in 30 seconds with 5-lb dumbbell	Upper-body muscular strength/power
2-Minute Step Test	Number of steps completed in 2 minutes	Muscular endurance
Chair Sit and Reach	Distance one can reach forward toward toes	Trunk/hamstring flexibility
Back Scratch Test	How far hands can reach behind the neck	Shoulder flexibility
8-Foot-Up-and-Go Test	Time required to get up from a chair, walk 8 feet and return to the chair	Agility, speed, and dynamic balance

Caucasian (94%), reported a history of heart disease (29.4%), hypercholesterolemia (47.1%), hypertension (70.6%), diabetes (29.4%), injuries to back or knees, (23%), and cancer (11%).

Protocol

The study was a one group pre- and post-test design conducted over a period of 10 weeks. Participants completed a demographic questionnaire, health history questionnaire, and informed consent form. Participants were then invited to complete baseline FP testing. Undergraduate Exercise Science students were trained to administer the Senior Fitness Test (SFT) by the principal investigator. The SFT was chosen to assess FP due to the fact that the physiological parameters needed to perform common everyday activities are included in the testing protocol and standards are available for evaluating physical performance (29) (See Table 1 for a description of the SFT). The SFT has been shown to be a valid and reliable battery of tests to assess functional performance in older adults (29). Other functional performance measures (e.g. Physical

Function Performance Test) were not administered due to financial and time constraints (9). Height and body weight were measured for calculation of body mass index (BMI). Functional fitness, body mass index, and body weight were measured again during the final session of week 10. All testing was conducted inside a designated recreational area at each facility. Exercise adherence was measured using session attendance. All study procedures were approved by the KWC institutional review board.

The intervention was administered in the recreational area of each facility twice per week for 10 weeks. The training intervention, Bingocize™, integrates bingo with exercises to keep the sessions interesting and enjoyable. Each 60 minute session consisted of between 35-40 minutes of exercise and 15-20 minutes of bingo. The protocols were identical at both facilities. Four trained undergraduate Exercise Science students led each session. The students were positioned around the room to assist the participants in performing the exercises. A session began with the

participants sitting at tables with their bingo cards and exercise equipment. Warm-up exercises consisted of stepping in place and stretching exercises preceded the start of the game (12). Participants performed three exercises that were followed by calling a bingo letter/number combination. See Table 2. This pattern was continued until a participant won the bingo game. A second game of bingo was played to allow for completion of the exercise protocol and to keep the participants interested in the program. Incentive prizes to encourage continued participation were awarded to the winner of each bingo game. Prizes (<\$2.00 USD each) were donated by local businesses or purchased with grant funds.

Participants completed 12-15 different exercises each session (Table 2). The selected exercises focused on improving cardiovascular (CV) fitness, muscular strength and endurance, flexibility, and balance using the American College of Sports Medicine guidelines for older adults (4). Beginning with one set of 8 repetitions for each exercise, participants progressed until they are able to complete 3 sets of 15 repetitions by the end of the study period. Intensity of exercise was monitored during each exercise using a modified Borg's perceived exertion scale (1= no exertion, 10 = maximum exertion) (5, 26). Participants were encouraged to maintain a moderate intensity (5 to 6 on the scale) when performing the exercises (7). The CV activities included walking and stepping in place or walking within the facility. Each CV bout lasted between 30-60 seconds. Participants completed a minimum of 20 minutes of CV exercise during each session.

Table 2. Bingocize™ exercise program.

Program component	Exercises
Warm-up	Walking in place
Flexibility	Single arm crossover
	Tricep stretch
	Head turns
	Head half-circles
	Calf-stretch w/ chair
Cardiovascular fitness	Walking in place
	Walking in facility
Lower body strengthening	Heel raises on balance pad w/one hand on chair
	Leg extension
	Hip adduction/abduction
	Ankle flex while standing
	Bicep curl
Upper body strengthening	Chest flies
	Chest press
	Lateral raises
	Reverse chest flies
	Body pumps
	Triceps extensions
	Side step on balance pad
Balance exercises	Walking in place on balance pad
	Staggered Stance
	Grapevine
	Static balance (single leg stance)
	Step ups on balance pad
Cool-down	See flexibility exercises

Note. Each session consisted of twelve-fifteen exercises selected from the program components above. After the warm-up, rolls of bingo were called between every 3 exercises. Balance exercises were added during week 5.

The muscular strength and endurance exercises were selected to most closely resemble functional movements and targeted major muscle groups. Beginning with one set of 8 repetitions for each

exercise, participants progressed until they were able to complete 3 sets of 15 repetitions by the end of the study period. Graded exercise bands (Black Mountain, Inc., Lakemoor, IL.) were used to improve muscular strength and endurance. With direction from the student leaders, participants chose between two different (light or extra light resistance) graded exercise bands. Airex balance pads (Magister, Inc., Chattanooga, TN.), used for standing exercises to improve balance, were introduced during week 5. These are soft foam square pads that challenge the participants to maintain their balance while performing the exercises. Balance pads have been used as part of a multi-component exercise program to reduce the risk of falls (22).

Statistical Analysis

Paired-sample *t*-tests were used to detect significant changes in the SFT, body weight, and BMI. Alpha levels were set at the $p < .05$ level. The statistical software Statistical

Package for the Social Sciences (SPSS, version 21.0, Chicago, IL) was used for statistical analysis. Because normative data exist for the SFT, changes in participants' percentile ranks before and after the study were compared.

RESULTS

Of the 18 original participants, 17 completed the study. One participant was forced to withdraw due to a terminal illness. Two of the remaining 17 participants were not able to complete the 2-minute step test due to musculoskeletal problems and confinement to a wheel chair, respectively. One participant could not complete the 8 foot up-and-go, chair sit and reach, or back scratch tests because of musculoskeletal problems. These participants were excluded from the final data analyses. Significant improvements were found in lower body muscular strength, upper body muscular endurance, cardiorespiratory endurance, lower body

Table 3. Pre and post senior fitness testing.

	N	Baseline		10 Weeks	
		M	SD	M	SD
BW (kg)	17	77.62	12.17	77.20	11.26
BMI (kg/m ²)	17	30.36	4.76	29.98	4.15
Chair Stand (stands)	17	10.13	3.01	11.71*	3.14
Arm Curl (repetitions)	17	9.78	4.37	12.35*	3.08
Chair Sit & Reach (cm)	16	-4.70	11.61	4.11*	6.99
Back Scratch Test (cm)	16	-13.03	10.36	-9.93*	8.97
8 Foot Up-&-Go (s)	16	9.07	2.29	8.81*	2.98
2-Minute Step Test (steps)	15	75.07	37.73	92.20*	16.46

Note. * = $p < .05$, two tailed. BMI = body mass index. BW = Body Weight.

Table 4. Results of paired-sample T-tests.

		Paired Differences					t	df	Cohen' sd	p
		Mean	SD	SEM	95% CI					
					LL	UL				
Pair 1	BMI	-0.21	1.37	0.33	-0.50	0.91	0.62	16	-0.05	.543
Pair 2	BW	-0.93	4.54	1.10	-1.41	3.27	0.84	16	-0.04	.411
Pair 3	Back scratch	1.22	1.49	0.37	0.42	2.01	3.26	15	0.63	.005*
Pair 4	8 Foot Up and Go	-0.65	.79	0.20	-1.09	-.21	-3.18	14	-0.10	.007*
Pair 5	Sit and reach	3.47	5.45	1.32	0.67	6.27	2.63	16	0.95	.018*
Pair 6	Arm curl	2.29	3.04	0.74	0.73	3.86	3.12	16	0.63	.007*
Pair 7	Chair stand	1.69	2.47	0.62	0.37	3.00	2.73	16	0.56	.015*
Pair 8	Step test	17.13	27.94	7.21	1.66	32.61	2.38	14	0.61	.032*

Note. * = $p < .05$, two-tailed. LL = lower limit. UL = Upper limit. BMI = body mass index. BW = Body Weight.

flexibility, upper-body flexibility, agility, and dynamic balance (See Tables 3 and 4). Small non-significant reductions in BMI and body weight were found (See Table 3). Exercise adherence was calculated by dividing the total number of attended sessions by the total number of sessions. Mean exercise adherence for the 10 week intervention was 81.11% (SD = 14.61%).

DISCUSSION

As a result of this investigation, we conclude participation in a 10-week multicomponent exercise intervention that included bingo as a program enhancer may significantly improve measures of functional fitness. The improvements in measures of functional fitness as a result of the specific exercises are comparable to

similar investigations targeting measures of functional fitness in older adults. For example, Freiberger and colleagues (14) compared three multicomponent exercise interventions over the course of 16 weeks and found a combination of strength, balance, and endurance training improved functional performance for up to 24 months.

Minimal levels of muscular strength and balance are necessary for older adults to remain mobile, capable of performing activities of daily living, and to reduce fall risk (25). All measures of muscular strength and balance were improved at the end our investigation. This is encouraging since 5 of the 17 participants were at serious risk of loss of functional mobility (\leq 5th percentile) for the chair stand at the beginning of the

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study. At the completion of the investigation, 3 of the 5 at risk for loss of functional mobility improved an average of 18 percentile points. (See Figures 1 and 2 for examples). Eleven of the 17 participants improved their chair stand percentile rank an average of 20 percentile points.

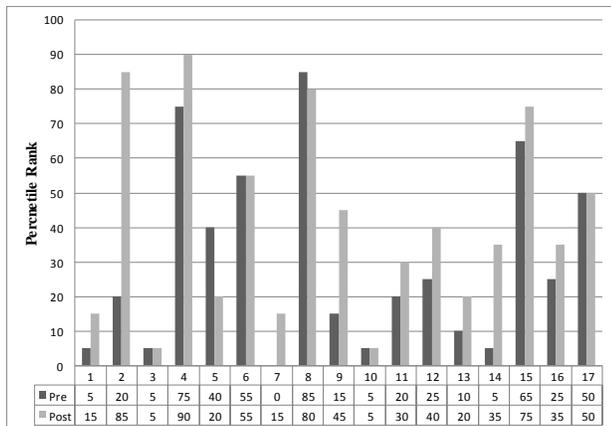


Figure 1. Participant pre and post chair stand percentile ranks.

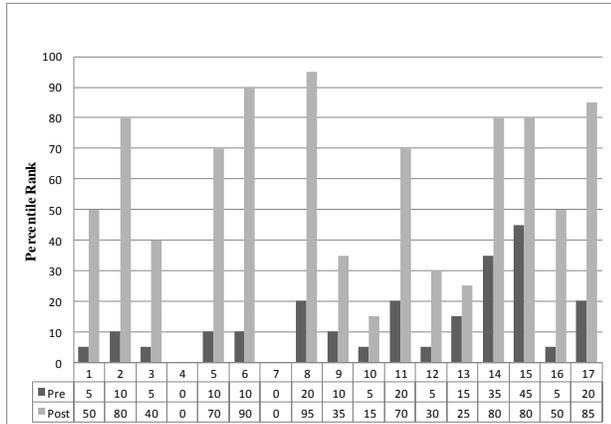


Figure 2. Pre and post 2-minute step test percentile ranks. Participants 4 and 7 did not complete due to preexisting musculoskeletal problems and confinement to a wheel chair, respectively.

Participants saw significant improvements in both upper and lower body flexibility from pre- to post-measurement. This is consistent with previous studies that have implemented exercise programs with older adults. In a 9-month training program with

over 200 older adults, Seco and colleagues (30) found similar improvements in flexibility, suggesting an increase in flexibility may prevent skeletal muscle disorders and improve mobility.

Cardiorespiratory fitness is important to improve older adults' ability to remain mobile even with existing chronic conditions (19, 20). The participants in our study performed a minimum of 40 minutes of stepping or walking per week at moderate intensity (5-6 on Borg's modified RPE scale). This protocol resulted in significant increases in the number of steps during the 2-minute step test. Similarly, during a 9-week multicomponent training program researchers used a moderate intensity (50% of heart rate reserve) walking component to improve 6-minute walk test in a comparable group of older adults (35).

While the intensity and duration were sufficient to improve measures of functional fitness in our study, the American College of Sports Medicine suggests further health benefits, including weight loss, can be obtained with 300 min/week or more of moderate intensity activity (8). It is likely we did not find significant improvements in BMI or BW because diet was not manipulated and/or the number of minutes of exercise per session was not sufficient to produce these effects. Similarly, others did not find significant differences in body weight using a multicomponent program of resistance, flexibility, and walking training over 9 weeks (29).

The unique addition of bingo as a program enhancer was successful at attracting and

retaining our participants. None of the participants were physically active before the start of the program, while 60% had never performed resistance training. Personal conversations with participants revealed they enjoyed the bingo game, but also appreciated the social support provided by student leaders and the other participants. These results are consistent with other investigations that have found older adults are more likely to participate in exercise programs that are enjoyable and allow for social support (8, 12). An investigation of the effectiveness of home and group-based, progressive resistance training programs and a group walking program in older adults residing in retirement villages found adherence rates were 66%, 63%, and 53% for the home, group-based, and walking group participants, respectively (9). The over 80% adherence rate for the Bingocize™ program compared favorably to all three of the programs. Others have found older adults are more likely to attend programs that meet 1-2 times per week; are low to moderate intensity; perceived social support; and, pleasure or displeasure associated with an exercise session (17, 23).

Future research should consider examining the effects of Bingocize™ on measures of cognitive function. Several researchers have suggested that long-term exercise interventions can yield significant improvements in cognitive function in older adults (2). It is possible that integrating the bingo game with exercise requires a larger amount of concentration and coordination on the behalf of the participants. Comments from participants suggested improvements in health-related quality of life, self-esteem, and mood. It is

also possible that the older adults' self-efficacy or confidence to participate in exercise was increased. Self-efficacy has been shown to play a critical role in maintenance of long-term adherence in older adults (23). Future researchers should examine these factors to confirm the validity of these improvements.

Future research should explore the use of bingo and exercise to improve activities of daily living (ADLs); instrumental activities of daily living (IADLs); and, reduction in fall risk. This study focused on older adults, but it may be a successful way to increase exercise participation in other populations such as children and adults who have physical or cognitive impairments. Community-based bingo games or *bingo halls* exist across the country and attract a variety of different people—many of them sedentary and smokers. It is estimated that over half of all community-based bingo players are smokers (24). Including a Bingocize™ program separately or in conjunction with existing community bingo games may be a unique approach to increase physical activity in a large sedentary population.

There were limitations in this study. First, the small sample size makes it difficult to generalize to a larger population. Future randomized, controlled trials with a larger sample size may be warranted to determine the efficacy of the program on a larger scale and with both genders. Secondly, the study lacked a sedentary control. However, Arnardottir and colleagues (3) suggested that older adults tend to participate in sedentary behavior more than other age groups. Using accelerometers to assess sedentary behavior (defined as less than

100 counts per min) time of ~15,000 older women (~70yrs), Shiroma and colleagues (31) found that over two-thirds of waking time is spent in sedentary behavior. Thus, the likelihood of otherwise participating in sedentary behavior and subsequent deleterious health outcomes suggests that the improvements in functional fitness seen in this sample are a result of the intervention.

Inexpensive and novel group exercise interventions are needed to attract and retain older adults to participate in sufficient amounts of exercise to improve functional fitness. Strong interest exists in the Bingocize™ program as evidenced by implementation at several government funded senior housing facilities, assisted living facilities, and senior citizen community centers across the United States (15). We believe the promising results of the current investigation may confirm its efficacy. Bingocize™ used callisthenic exercises with the addition of graded exercise bands and balance pads. This equipment is relatively inexpensive, readily available in stores, and easily transported, highlighting the ease at which this program can be replicated. Four undergraduate students were used to implement the program at each senior facility, however, with simple training could be easily administered by a single senior facility staff member or volunteer. The low-cost, sustainability, and ease of implementation suggest that this may be a novel and enjoyable alternative to traditional older adult group exercise interventions.

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