



ISSN: 0975-833X

Available online at <http://www.journalcra.com>

INTERNATIONAL JOURNAL  
OF CURRENT RESEARCH

International Journal of Current Research  
Vol. 14, Issue, 08, pp.22120-22122, August, 2022  
DOI: <https://doi.org/10.24941/ijcr.43848.08.2022>

## RESEARCH ARTICLE

# EXPLORING THE PHYSICAL EFFECTS OF A MOBILE APP-BASED SOCIAL GAME ON POLISH OLDER ADULTS. A PILOT STUDY

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### ARTICLE INFO

#### Article History:

Received 19<sup>th</sup> May, 2022  
Received in revised form  
05<sup>th</sup> June, 2022  
Accepted 24<sup>th</sup> July, 2022  
Published online 30<sup>th</sup> August, 2022

#### Key words:

Aging, physical activity, verbal fluency, seniors, social, Poland.

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### ABSTRACT

**Introduction:** Adopting healthy lifestyles such as reasonable physical activity, a balanced diet, and stable lean body weight are known to reduce risk factors for heart disease thus slowing the process of inevitable aging (Bamidis *et al.* 2014). Bingocize® was created as an intervention to not only attract older individuals but to retain their attention by utilizing a fun, interactive game to allow for the exercise of the body and mind (Crandall, *et al.* 2011). Bingocize® allows individuals to be more social, which has proved to increase one's lifespan (WHO, 2018), to become more physically active, and to exercise the mind. These all are important components of one's longevity. The cognitive function is exercised by use of health-related questions incorporated into the Bingocize® game. The game also includes physical exercises for adults to increase balance, strength, muscle tone, and coordination. The increase in physical fitness will allow older adults to combat the natural process of aging where there is a natural degeneration of muscles and cognitive functioning. By continuing to exercise these parts, we are able to live longer, and healthier lives (Crandall *et al.* 2015). **Aim of the Study:** The aim of the study was to determine if Bingocize® (a mobile app-based social game) after a 12 week program was an effective tool for improving physical fitness and lowering body weight in Older adults in Krakow, Poland. **Materials and Methods:** Older adults attending the Krakow, Poland Senior Center (N=36; age 72.41 ±9.23) were recruited and randomly assigned to (a) experimental (n=19; social game with exercise) or (b) control (n=17 no exercise) condition. Pre/post measures used in the 12 week intervention were: body weight, physical fitness (using Senior Fitness Test composed of 6 trials). Statistical analysis included a mixed-model ANOVA (p < .05). **Results:** Significant differences were observed in subgroups (pre/post) for body weight, chair stand, arm curl, and step test in both experimental and control group. Significant differences were observed in subgroups (pre/post) in experimental only for chair sit and reach, 8ft up and go, and back scratch. Significant differences were observed in control vs. experimental in chair stand in pre intervention and arm curl test. **Conclusion:** Bingocize® may be an effective tool to improve some aspects of physical fitness in older adults.

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Citation: Deryaev Annaguly Rejepovich. 2022. "Exploring the Physical Effects of a Mobile App-Based Social Game on Polish Older Adults. A pilot study". *International Journal of Current Research*, 14, (08), 22120-22122.

## INTRODUCTION

Physical fitness is one of the most important factors which contributes to a long and healthy life. It is associated with better physical and cognitive functioning in later life and with increased life expectancy (Chodzko-Zajko *et al.* 1994). Bingocize® was created as an intervention to not only attract older individuals but to retain their attention by utilizing a fun, interactive game to allow for the exercise of the body and mind. The number of people aged 60 or older will rise from 900 million to 2 billion between 2015 and 2050 moving from 12% to 22% of the global population (WHO, 2015). Population aging is inevitable and with advances being made on all fronts it is happening at a much quicker rate than in the past. The Administration on Aging (U.S. Department of Health & Human Services, 2012).

projects that by 2040, older adults (persons 65 and older) will represent 21% of the population. The population of older people in the European Union will increase significantly, rising from 90.5 million at the start of 2019 to reach 129.8 million by 2050 (Eurostat 2013). Similar to the EU Poland's population is aging. The median age in Poland has increased from 28.8 years in 1950 to 38.5 in 2012 and it is projected to further increase to 51 years by 2050 (Devictor, 2012). The human population as a whole continues to live longer. For those born in the second half of the 20th century, chronic diseases replaced acute infections as the major causes of death. Today, death in the United States is largely reserved for the elderly. Roughly three-fourths of all deaths are at ages 65 and older (WHO, 2018). How we continue to live our best possible lives is a question often asked by not only common people but by experts. There have been numerous studies on the aging population and this continues to be a popular source of study.

To find a solution for improved quality of life at advanced age, we must be able to identify the problems that occur with an aging population. There seems to be conflicting ideas behind the notion that we will continue to observe advances in life expectancies in the 21st century. Some experts (Gorina Y, *et al* 2006) say we cannot continue to reduce mortality at the oldest ages without making dramatic and unforeseen medical advances against such major killers as cardiovascular disease and cancer; however, others argue that it is not only possible but likely as we reap the benefits of a more robust, better educated population taking better care of themselves and using modern medical technologies and therapies (Sayhoun *et al.* 2001). Exercise is shown to be an important component of a multifactorial intervention, particularly when applied consistently for ten weeks or longer (Dizdar, Irdesel, Dizdar, & Topsaç, 2017). Mobility impairment and low physical performance can predict the loss of independence in the ability to perform activities of daily living (Idland *et al.*, 2013). Physical activity has been shown to improve balance and reduce the risk of falls in later life (Nelson *et al.*, 2007). Indeed, regular exercise has beneficial effects on older people's physical function: improving mobility, flexibility, and upper and lower limb function (Barry *et al.*, 2014).

Using community-based group exercise programs which incorporate motivators, such as social support, has been shown to be one approach to increase physical activity levels and adherence for older people (Hernandes *et al.* 2013). Bingocize® includes all three key components: exercise of mind and body in a social environment. Bingocize® is a simple program that strategically combines the game of bingo and exercise in either 12 or 10-week studies of the program. Older adults residing in assisted living facilities attended over 80% of the sessions. Bingocize® significantly improved muscular strength, flexibility, balance, and cardiorespiratory fitness as assessed using the Senior Fitness Test battery. As a result the Bingocize® program met the U.S. Department of Health and Human Service Administration on Aging's highest-level criteria for evidence-based disease prevention and health promotion programs. Therefore the purpose of the study was to explore the physical effects of a mobile based application social game on Polish older adults and to evaluate the efficacy of a mobile app-based-social game to increase physical activity in older adults.

## MATERIALS AND METHODS

Older adults attending the Krakow, Poland Senior Center (N=36; age 72.41  $\pm$  9.23) were recruited and randomly assigned to (a) experimental (n=19; social game with exercise) or (b) control (n=17 no exercise) condition. Pre/post measures used in the 12 week intervention were: body weight, physical fitness (using Senior Fitness Test composed of 6 trials). Statistical analysis included a mixed-model ANOVA (p < .05). These tests were chosen to test physical fitness levels pre and post 12 week intervention. The Senior Fitness Test (SFT) (Rikli, Jones, 2013) is composed of 6 parts. Listed are each of its components: 1. Chair Stand, 2. Arm Curl, 3. Two Minute Step Test, 4. Chair Sit and Reach, 5. Up and Go, 6. Back Scratch Test. Pre and post test levels were compared whether or not there was significant improvements made in the SFT. In Bingocize the main goal of the physical fitness component is to improve measures of functional performance. Functional performance is important for older adults to perform activities of daily living; this was measured by The Senior Fitness Test. Bingocize was offered twice per week and each meeting was 45- to 60-min long. In the game participants were asked to perform exercises alternating with health questions and then as a result were rewarded with a number for their Bingocize digitalized chart (which was on a tablet). Approval from the Senate Committee on Research Ethics at the Jagiellonian University in Krakow, Poland, 2018, was obtained prior to the study. All participants gave written and informed consent for participation and publication of this report in accordance with the guidelines established by the Declaration of Helsinki. Project has been registered and allocated in the Australian New Zealand Clinical Trials Registry (ANZCTR); number: ACTRN12618001678280p

## RESULTS

Significant differences were observed in subgroups (pre/post) for body weight, chair stand, arm curl, and step test in both experimental and control group. Significant differences were observed in subgroups (pre/post) in experimental only for chair sit and reach, 8ft up and go, and back scratch. The results can be observed in table 1. The remaining variables were non-significant. Significant differences were observed in control vs. experimental in chair stand in pre intervention where p value is .0049 and post intervention where p value is .0026. Significant differences were observed in control vs experimental group pre intervention for arm curl where p value is .0128 and post intervention is .0067. Significant differences were also seen in both pre intervention and post intervention in control vs experimental groups with a p value of .0233 and .0021 respectively. Significant difference was observed in control group vs experimental group for post intervention for step test with a p value of .0009. All other variables were non significant. These values can be observed in table 2.

## DISCUSSION

In a previous study by Crandall *et al.*(2015), Bingocize® was administered to 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 functional performance (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). In a pilot study by Crandall and Steenbergen (2015), physically inactive older adults attended twice weekly sessions, 45-60 minutes long, at a community senior center for 10 weeks. The participants significantly improved on 7 of the 8 measures of functional performance when compared to a waitlisted control group. Pre/post functional performance and health education knowledge were compared using mixed ANOVA (p < .05). Short Physical Performance Battery ( $\lambda = .584$ , F (1, 10) = 6.41, p = .032,, and gait velocity ( $\lambda = 6.10$ , F (1, 10) = 6.40, p = .030,) were significantly improved in the IG only. Bingocize has been shown to be an effective way to increase physical activity and fitness levels in the elderly as was shown in this pilot study. Further research needs to be completed with a larger sample size to be able to determine effectiveness of the mobile based app. As one of the limitations was the sample size in this study. In previous studies mentioned by Crandall *et al* 2015, Bingocize had also shown positive results in physical fitness activities and older adults in the United States with larger sample sizes. The success of physical fitness programs is the rate of adherence and retention; the commitment to physical fitness is a journey. According to WHO (2019) there are plenty of health education programs available but the rate of chronic diseases continue to increase due to poor lifestyle choices. WHO came to the conclusion that only 50% of chronic disease patients adhere to therapeutic treatments such as medication management, physical activity and diet modifications. In this Poland study the adherence rate was 93-95% which was comparatively high to Crandall *et al.* (2015) studies which was 80% (considered also high). This is promising for future similar studies as this shows interest and commitment to the program. While the adherence rate was high in all studies, it is important to note that in these studies the participants were rewarded for completing the program. These studies may not be as successful if there was not any rewards provided at the end of the experiments. The study in Poland was comparatively more difficult to implement as the game Bingo itself is not well or if at all known. There was a portion of time prior to the studies dedicated to educating the elderly not only how to play the game (Bingocize) but also how to use a tablet. The cultural difference here was something that was to be overcome and was well received. This could continue to be a potential barrier in the ease of implementing such a program in the Polish community.

**Table 1. Pre vs post comparison in control and experimental groups. Significant differences (p<0,05) are shown in bold**

Variables	Control group			Experimental group		
	Pre	Post	p	Pre	Post	p
	Mean ± SD	Mean ± SD		Mean ± SD	Mean ± SD	
Weight	70,72 6,80	70,92 6,66	<b>0,0337</b>	70,54 6,27	70,26 6,28	<b>0,0032</b>
Chair stand (repetitions)	12,06 4,94	14,29 4,06	<b>0,0024</b>	16,53 4,72	19,26 4,65	<b>0,0003</b>
Arm Curl (repetitions)	19,59 6,49	21,76 5,66	<b>0,0011</b>	24,74 5,65	26,89 6,847	<b>0,0000</b>
Step Test (repetitions)	88,59 33,11	97,76 31,89	<b>0,0069</b>	108,95 33,29	139,32 38,95	<b>0,0000</b>
Chair sit and reach (cm)	-2,65 14,89	-1,23 13,84	0,1604	0,79 8,48	3,58 5,86	<b>0,0051</b>
8ft up and go (s)	7,89 4,12	7,43 3,42	0,3215	5,76 0,85	5,00 0,58	<b>0,0000</b>
Back scratch (cm)	-8,35 20,07	-6,71 15,80	0,8322	-3,47 8,83	-1,74 8,46	<b>0,0021</b>

**Table 2. Pre and post comparison in control vs experimental groups. Significant differences (p<0,05) are shown in bold**

Variables	Control vs experimental group			Control vs experimental group		
	Pre	Post	p	Pre	Post	p
	Mean ± SD	Mean ± SD		Mean ± SD	Mean ± SD	
Weight	70,72 6,80	70,54 6,27	0,9340	70,92 6,66	70,26 6,28	0,7607
Chair stand (repetitions)	12,06 4,94	16,53 4,72	<b>0,0049</b>	14,29 4,06	19,26 4,65	<b>0,0026</b>
Arm Curl (repetitions)	19,59 6,49	24,74 5,65	<b>0,0128</b>	21,76 5,66	26,89 6,847	<b>0,0067</b>
Step Test (repetitions)	88,59 33,11	108,95 33,29	0,0857	97,76 31,89	139,32 38,95	<b>0,0009</b>
Chair sit and reach (cm)	-2,65 14,89	0,79 8,48	0,3640	-1,23 13,84	3,58 5,86	0,2059
8ft up and go (s)	7,89 4,12	5,76 0,85	<b>0,0233</b>	7,43 3,42	5,00 0,58	<b>0,0021</b>
Back scratch (cm)	-8,35 20,07	-3,47 8,83	0,5294	-6,71 15,80	-1,74 8,46	0,2999

The pilot study had its limitations due to sample size. There needs to be a large sample size in order to provide us with a larger statistical report that is verifiable. The larger sample size and results would be able to more closely approximate the population and reduce interference; we also need to include questionnaires to assess how active the participants were during the study

## CONCLUSION

A mobile app-based social game promoting physical activity may be an effective tool to improve some aspects of physical fitness of older adults. Future investigations with larger sample sizes to examine the effects of the mobile app on quality of life and nutrition behaviors. Experimental group increased significantly in all the tests.

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