

A Community-Based Exergaming Physical Activity Program Improves Readiness-to-Change and Self-Efficacy Among Rural-Residing Older Adults

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Rural-residing older adults (OA) are not meeting physical activity (PA) recommendations, such that identifying methods of increasing PA among OA remains an ongoing challenge. This study evaluated the effect of a community-based exergaming program on PA readiness-to-change and self-efficacy among rural-residing OA ($n = 265$). There was a significant ($p = .008$) increase in readiness-to-change classification from PRE to POST. Significant increases in self-efficacy, or confidence in their ability to be physically active for a prescribed period of time, were detected for 35 ($p = .011$) and 40 min ($p = .035$) of continuous PA. PA self-efficacy change for 35 min of continuous PA ($F[3,137] = 3.973, p = .010$) and 40 min of continuous PA ($F[3,137] = 2.893, p = .038$) were influenced by the interaction between PRE self-reported health and PRE PA readiness-to-change levels. Results suggest that an exergaming-themed PA intervention is effective at increasing PA participation and self-efficacy for PA among rural-residing OA.

Keywords: exergaming, older adults, rural, physical activity, self-efficacy

Providing opportunities for rural-residing older adults (OA) to be physically active is important for their health and well-being. OA (65 years and older) now comprise 13.3% of the overall United States population (Administration on Aging and the Department of Health and Human Services, 2012). Rural-residing OA make up approximately 20% of the OA population of the United States (National Rural Health Association [NRHA], 2011). Rural-residing OA report lower frequency of physical activity (Behavioral Risk Factor Surveillance System [BRFSS], 2013) and have worse physical health, decreased socialization, and lower health-related quality of life than their urban-residing counterparts (Baerenholdt, Yan, Hinton, Rose, & Mattos, 2012; Hawton et al., 2010).

OA often face barriers in meeting the recommended physical activity (PA) guidelines for Americans. Common PA participation barriers include lack of time, risk of injury, lack of discipline, decreased motivation, boredom, and intimidation (Costello, Kafchinski, Vrazel, & Sullivan, 2001). OA prefer PA programs that are accessible, safe, free, convenient, and fun, as well as those having knowledgeable staff and a social component (Carlson et al., 2012; Costello et al., 2001).

An important determinant of becoming more physically active in older adulthood is self-efficacy (Orsega-Smith, Payne, Mowen, Ho, & Godbey, 2007). Having higher self-efficacy increases the likelihood of changing or maintaining a certain behavior, while lower self-efficacy decreases the likelihood of changing a behavior (Orsega-Smith et al., 2007). OA who exercise more frequently and who have social support throughout an exercise routine or program

have increased levels of self-efficacy (McAuley, Wójcicki, Gothe, Mailey, & Szabo, 2013). Therefore, PA interventions for OA that are welcoming and group-based may positively affect self-efficacy and lead to a higher incidence of maintaining PA after the intervention ends.

Increasing PA among rural-residing OA is challenging. Despite the numerous benefits associated with regular PA, OA are the least physically active age group (BRFSS, 2013; Carlson et al., 2012) and less than one-third of OA are meeting the recommended PA guidelines (National Council on Aging [NCOA], 2014). This rate of physical inactivity is more prevalent in rural areas where rural-residing OA are half as likely to be physically active as urban-residing adults (Shores, West, Theriault, & Davison, 2009). Rural-residing OA commonly have decreased access to healthcare options and may not participate in PA due to limited social support (Shores et al., 2009), access, and convenience (Costello et al., 2001). Additionally, rural areas are further away from urban areas and often do not have fitness centers that are accessible to the entire population (National Rural Health Association, 2011).

Exergaming, or the combination of exercise with a video game (i.e., Wii[®] and XBOX Kinect[™]; Chao, Scherer, Wu, Lucke, & Montgomery, 2013; Maillot & Perrot, 2012; O'Leary, Pontifex, Scudder, Brown, & Hillman, 2011), has promise as an effective tool to overcome these challenges. Exergaming systems allow individuals to interact with a virtual environment to become more active. It works by tracking movements from the player and shows them on the screen by using remotes as seen in Wii[®] (Nintendo, Kyoto, Japan) gaming systems and a camera sensor in Xbox Kinect[™] (Microsoft, Redmond, WA) systems (O'Leary et al., 2011). Exergaming has gained popularity in recent years and is growing in popularity among older adults (Maillot & Perrot, 2012). Adherence to PA program regimens can be challenging for OA, but exergaming could serve as a means to increase PA program adherence (Maillot & Perrot, 2012). A structured, group-based, exergaming-oriented PA program can positively affect PA participation (Strand, Francis, Margrett, Franke, & Peterson, 2014), balance (Chao et al., 2013),

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mobility (Chao et al., 2013), and depressive symptoms (Dionigi, 2007; Rosenberg et al., 2010) among OA. Furthermore, boredom with exercise is a common barrier to exercise in OA (Chao et al., 2013). Exergaming systems (i.e., Xbox Kinect™ and Wii®) can be an effective way to increase PA enjoyment particularly among OA. Chao et al. (2013) found that the OA in their study reported Wii® exergaming to be pleasurable and wished to continue exercise.

The Living (well through) Intergenerational Fitness and Exercise (LIFE) Program (Strand et al., 2014) is an exergame-focused, group-based PA program for rural-residing OA aged 60+ (Table 1). It is designed to be delivered through community agencies (e.g., Cooperative Extension, senior centers, retirement communities) and to overcome the many barriers toward PA faced by rural-residing OA. The attributes of the LIFE program that make it ideal for delivery in rural areas, where there is likely a shortage of exercise experts, include: (1) use of technology (i.e., exergaming) to promote PA limits the need for extensive PA training of personnel; (2) relatively low cost, requiring the exergaming equipment, television, interactive game supplies, and printing and distribution of LIFE Lessons Newsletters; (3) extensive training materials, including “how-to” videos, promotional videos, training manual, training CD, and a website (<http://www.extension.iastate.edu/life/>); and (4) a needed service for an underserved audience (i.e., rural-residing OA).

To our knowledge, only limited research has been conducted on PA-related self-efficacy and self-perceived PA level changes among rural-residing OA when participating in an exergaming PA program. This study examined the effects of the LIFE program on PA-related readiness-to-change and self-efficacy (defined as the confidence and belief that one can make the recommended behavior changes).

Methods

LIFE Program Overview

The LIFE program (Strand et al., 2014) was developed using two theoretical models, the Transtheoretical Model (TTM) and the Whole Person Wellness Model (WPWM) (Montague & Frank, 2007; Montague, Piazza, Peters, Eippert, & Poggiali, 2002; Prochaska & Velicer, 1997). The TTM suggests that individuals move through five distinct phases related to readiness to change (precontemplation, contemplation, preparation, action, and maintenance) to achieve a behavior change (Prochaska & Velicer, 1997). The LIFE program targets those in contemplation through preparation, but has components for those in action and maintenance as well. The WPWM incorporates six main wellness dimensions: physical, emotional, spiritual, intellectual, vocational, and social (Montague & Frank, 2007; Montague et al., 2002). Physical wellness consists of the desire and need for physical activity, nutrition, and the decrease of drugs and alcohol (Montague & Frank, 2007; Montague et al., 2002). Decreasing bad habits (i.e., physical activity and nutrition) and increasing good habits (i.e., physical activity and nutrition) can contribute to overall wellness (Montague & Frank, 2007; Montague et al., 2002). Emotional wellness encompasses forming healthy relationships with others built on trust and respect (Montague & Frank, 2007; Montague et al., 2002). Healthy relationships contribute to wellness and success in an individual’s life (Montague & Frank, 2007; Montague et al., 2002). Spiritual wellness is the search of purpose and meaning of a person’s life, and can be the path to what their morals and beliefs are on issues (Montague & Frank, 2007; Montague et al., 2002).

Table 1 LIFE Program Overview

Program Component	Activities	Whole Person Wellness Model Component	Transtheoretical Model Stage(s)
Onsite Program			
• 30-60 min of physical activity^a twice weekly using Xbox Kinect™ exergaming technology using Kinect Sports™ • Led by younger adult trainers ◦ High school and college-aged students (16-26 years) who led the onsite physical activity sessions ◦ Provided intergenerational component	Weeks 1-2 • 30 min exergaming activity twice weekly • 30 min interactive games (e.g., crossword, have you ever, etc.) twice weekly • Difficulty level: beginner Weeks 3-4 • 30 min exergaming activity twice weekly • Start onsite leader recruitment and training^b • Difficulty level: amateur Weeks 5-8 • 30 min exergaming activity twice per week • Difficulty level: professional	• Physical • Social • Emotional • Intellectual	• Action • Maintenance (if participant was already physically active)
Newsletter Phase (16 weeks)			
• Bi-monthly newsletters (8 total) mailed to participants after onsite program • Onsite leader-led LIFE Program encouraged to continue	Nutrition and Fitness (4 newsletters) • Included exercise tips and healthy recipes Emotional and intellectual wellness (4 newsletters) • Included mental and emotional wellness tips, etc.	• Physical • Emotional • Intellectual	• Contemplation • Preparation • Action • Maintenance

^aActivities included volleyball, bowling, soccer, table tennis, track and field, and boxing.

^bOnsite leaders were recruited from current older adult participants to continue leading the program after the completion of the onsite component.

Intellectual wellness is the increase of knowledge in creativity and scholarly pursuits (Montague & Frank, 2007; Montague et al., 2002). Vocational wellness is the satisfaction felt while at work and how happy they are with what they do on a daily basis (Montague & Frank, 2007; Montague et al., 2002). The last dimension, social wellness, is the interaction between an individual and their environment and community (Montague & Frank, 2007; Montague et al., 2002). These six dimensions are important in achieving overall wellness and can help an individual have an increased sense of wellbeing and increased confidence (Kang & Russ, 2009). The LIFE program incorporates elements related to physical, emotional, intellectual, and social aspects of whole-person wellness (Table 1).

The LIFE program was implemented in 31 Midwestern counties that met the USDA definition of “rural;” these were counties with a rural-urban continuum code of four or higher and were defined as “non-metro” (Economic Research Service [ERS], 2008). Host site locations included churches, retirement communities, assisted living communities, community centers, wellness centers/gyms, and offices of Iowa State University Extension and Outreach. The 8-week onsite PA program utilized exergaming technology (i.e., Xbox Kinect™ Sports). Depending on the activity, one to two participants were asked to volunteer to be the “avatar” (i.e., the Kinect scanner would follow their movements). The Xbox Kinect™ Sports game demonstrated each exercise and provided encouragement and support throughout the session. Other participants joined in the same exercises while standing behind the two participants serving as the “avatars.” The PA movements were repeated throughout the weeks to enhance familiarity. Youth trainers supervised and helped the participants perform the exercises correctly and safely. The program participants met twice a week for 30 min each time and began exercising at a relatively low level of intensity. Exercise intensity was slowly increased throughout the program. Workouts varied from week to week and alternated between the major muscle groups (i.e., lower and upper body). Programs were held at various times throughout the year.

Recruitment

OA ($n = 265$) were recruited through direct (i.e., in-person presentations and word of mouth) and indirect (i.e., flyers and press releases) methods at community locations where OA gathered (e.g., senior centers, community centers, retirement communities, congregate mealsites). Inclusion criteria included being 60+ years of age, able to participate in a PA program, and willing to complete written questionnaires. Additionally, to participate in the exergaming program participants needed to be able to function independently and take care of personal needs as well as able to communicate needs and comprehend information and directions for an activity. Finally, no caregiver proxies were used to gather information. A PA readiness questionnaire (PARQ; British Columbia Ministry of Health Department of National Health and Welfare, 2002) was provided to participants as a guide to self-determine whether or not they should participate in the LIFE program. Although not required, participants were encouraged to seek medical advice if they answered “yes” to any of the questions.

Measures

Data were collected at the start (PRE, Week 1, Day 1) and end (POST, Week 8, Day 2) of the LIFE program. Measurements included general sociodemographic questions (age, gender, ethnicity, self-reported health status, living arrangements, marital status, and

contact with younger adults), self-reported PA readiness-to-change, self-efficacy to overcome perceived barriers to PA, and PA self-efficacy. Education status and cognitive status were not measured.

Self-reported health status was assessed by asking participants to describe their health using a 5-point Likert scale (ranging from Very poor [1] to Very good [5]). Self-reported PA readiness-to-change was measured using the Cancer Prevention Research Center Exercise: Stages of Change—Short Form (Cancer Prevention Research Center, 2010). The definition of PA provided to participants was “for PA to be considered ‘regular’ it must be done for 30 minutes at a time (or more) per day, and be done at least five days per week. The intensity of activity does not have to be vigorous but should be enough to increase your heart rate and/or breathing level somewhat. Examples of activities could include brisk walking, leisure biking, swimming, line dancing, and aerobics classes or any other activities and other activities with a similar intensity level.” For purposes of data analysis, those who self-identified as being in the stages of “precontemplation,” “contemplation,” or “preparation” were categorized as “not physically active,” while those who self-identified as in the “action” or “maintenance” stages were categorized as “physically active.”

The Self-Efficacy for Exercise Scale was used to measure perceptions of self-efficacy to exercise in the face of barriers (Resnick & Jenkins, 2000). Participants rated their ability and confidence to exercise 20 min, 3 times weekly during commonly identified barriers (e.g., weather, boredom, pain) using a 10-point Likert scale (1 = not very confident, 10 = very confident). Responses were reported as the mean score (maximum = 10). In addition, the Confidence for Exercise Scale was used to assess PA self-efficacy (Bray & Cowan, 2004). Participants rated their confidence to participate in continuous PA from 0% to 100% confident for each specified amount of time in 5-min increments ranging from 5 min to 45 min. Confidence percentiles were then averaged in order to create a total PA self-efficacy score. To be consistent with PA recommendations for adults (i.e., at least 30 min of PA daily; American Heart Association, 2014), 5-min increments of 30 min and above were examined.

Data Analysis

Data were analyzed using the IBM Statistical Package for the Social Sciences (SPSS; Armonk, NY) for Windows, version 21.0 software. Descriptive statistics were used to analyze demographic and qualitative data. The criterion for statistical significance in subsequent analysis was determined based on $p < .05$.

Changes in self-reported PA readiness-to-change from PRE to POST were analyzed using the Pearson chi-square test of independence. The change in self-efficacy for overcoming PA barriers was analyzed as an average total score using general linear models (GLM) regression controlling for age, PRE health status, and PRE PA readiness-to-change. Predictors of PA self-efficacy change (Confidence for Exercise Scale) from PRE to POST were analyzed using GLM regression controlling for age, PRE self-reported health status, and PRE PA level. Finally, change in total PA self-efficacy and self-efficacy level for 30, 35, 40, and 45 min of continuous PA from PRE to POST was analyzed using a paired samples t -test.

Results

Demographics

The majority of participants were community-residing, widowed, White females, ages 70–89 years, who rated their health as “good”

(Table 2). The LIFE program had a 58% completion rate ($n = 154$ out of 265) from PRE to POST as determined by the completion of PRE and POST questionnaires. Age was the only significant variable ($p = .016$) associated with completion, with those age 84 years or younger being more likely to have completed both PRE AND POST questionnaires.

PA Readiness-to-Change

There was a significant increase in the number of participants who self-identified as “physically active” from PRE to POST ($p = .008$) per the readiness-to-change questionnaire (Figure 1). At PRE, 57 (37%) participants self-identified as “not physically active” while 97 (63%) self-identified as “physically active.” At POST, 43 (29%) participants self-identified as “not physically active” while 111 (72%) self-identified as “physically active.” Of the 111 “physically active” participants at POST, 77 (79%) self-identified as “physically active” at both PRE and POST, while 34 moved from “not physically active” to “physically active” from PRE to POST.

Table 2 Description of LIFE Program Participants ($n = 265$)

Characteristic	Number (n)	Percent (%)
Age		
Young-old (65–74 years)	100	37.7
Old (75–84 years)	96	36.2
Old-old (85+ years)	69	26.0
Gender		
Female	221	83.4
Male	39	14.7
Not reported	5	1.9
Ethnicity		
White	245	92.5
Other	7	2.6
Not reported	13	4.9
Marital status		
Single, never married	7	2.6
Married	106	40.0
Divorced	13	4.9
Widowed	134	50.6
Not Reported	5	1.9
Living arrangement		
Community-residing	175	66.0
Independent and/or assisted living	69	26.0
Other	18	6.8
Not reported	3	1.1
Self-reported general health at baseline		
Poor/average	113	42.7
Good	149	56.2
Not reported	3	1.1
Readiness-to-change classification at baseline		
“Not physically active”	94	35.5
“Physically active”	170	64.2
Not reported	1	9.6

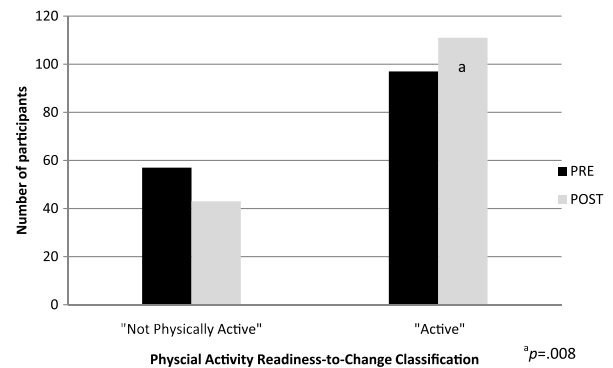


Figure 1 — Physical activity readiness-to-change classification from PRE to POST.

Self-Efficacy

No changes in total PA self-efficacy from PRE to POST were detected. However, significant increases were detected for mean PA self-efficacy change in self-reported confidence to complete 35 min ($\bar{x} = 7.01 \pm 31.91$; $p = .011$) and 40 min ($\bar{x} = 5.87 \pm 32.60$; $p = .035$) of continuous PA ($n = 139$; Table 3). PRE self-reported health status and PRE PA readiness-to-change levels did not predict PA self-efficacy change from PRE to POST for 30 and 45 min of continuous PA. PA self-efficacy change for 35 min of continuous PA ($F [3,137] = 3.973$, $p = .010$) and 40 min of continuous PA ($F [3,137] = 2.893$, $p = .038$) were predicted significantly by the interaction between PRE health and PRE PA readiness-to-change levels (Table 4). Additionally, PRE self-reported health status significantly predicted change in self-efficacy for PA barriers ($p < .001$) (Table 4). Participants who self-identified as “physically active” and in “good health” at PRE were more likely to experience an increase in PA self-efficacy. Similarly, participants who self-identified as in “good health” at PRE were more likely to experience an increase in self-efficacy for PA barriers.

Discussion

These results suggest that an 8-week exergaming-themed PA promotion program for rural-residing OA may be an effective approach in helping to increase both PA readiness-to-change and PA self-efficacy in participants’ perceived ability to engage in 35 and 40 min of continuous PA, which goes well for ability to meet recommended PA guidelines. The findings of this study are supportive of the current evidence that there is a strong connection between self-efficacy and PA participation (Ayotte, Margrett, & Hicks-Patrick, 2010; French, Olander, Chisholm, & McSharry, 2014) and PA adherence (Brassington, Atienza, Perczek, DiLorenzo, & King, 2002).

The number of participants self-identifying as “physically active” increased during this 8-week period. This result supports findings from the LIFE program pilot study in which Strand et al. (2014) found an increase in those who viewed themselves as “active” following the 8-week onsite program and at follow-up (25 weeks). The changes detected with the LIFE program from PRE to POST may be attributable to the program’s inclusion of a group design that provides opportunities for socialization and exergaming. This finding mirrors Ayotte et al. (2010), who reported an association between greater social support and higher self-efficacy among OA. Similarly, McAuley et al. (2013) reported increased levels of self-efficacy and exercise levels among OA who exercised more frequently and had more social support throughout

Table 3 Self-Efficacy Change for Confidence in Completing Continuous Physical Activity for a Set Duration

Continuous Activity Duration (# of Participants)	PRE Mean % Confidence	POST Mean % Confidence	Mean Change $\pm$ SD	<i>d</i>	<i>p</i> -Value
30 min (n = 141)	61.1	66.1	5.06 $\pm$ 34.23	.148	.081
35 min (n = 136)	50.8	57.8	7.01 $\pm$ 31.91	.220	.011
40 min (n = 138)	45.1	50.9	5.88 $\pm$ 32.60	.180	.035
45 min (n = 137)	41.8	45.9	4.12 $\pm$ 31.83	.130	.132

Table 4 Significant Predictors of Physical Activity Self-Efficacy Change

	<i>df</i>	<i>F</i>	Partial Eta Squared	<i>p</i> -value
Self-efficacy change for 35 min of continuous PA ^a				
Baseline readiness-to-change * health status	3	3.973	0.085	.010
Self-efficacy change for 40 min of continuous PA ^b				
Baseline readiness-to-change * health status	3	2.893	0.063	.038
Self-efficacy for PA barriers ^c				
Health status	1	4.453	0.117	<.001

Adjusted R^2 = ^a.047; ^b.013; ^c.366.

an exercise routine or program. Furthermore, exergaming has been shown to be an effective way to increase adherence to PA (Maillot & Perrot, 2012) and is popular among OA (Maillot & Perrot, 2012; Strand et al., 2014).

Self-efficacy is closely related to PA participation (Ayotte et al., 2010; French et al., 2014; Orsega-Smith et al., 2007). Among the recent cohort, an increased self-efficacy for perceived ability to complete 35 and 40 min of continuous PA was seen from PRE to POST. This finding offers promise for participants' future PA, as previous research has reported that a higher level of self-efficacy is related to greater PA participation (Orsega-Smith et al., 2007; Wilcox, Bopp, Oberrech, Kammermann, & McElmurray, 2003) and greater maintenance of PA 6 months beyond a program's end (Brassington et al., 2002).

In addition, those who are confident in their ability to be physically active for 35 and 40 min consecutively are more likely to meet the PA recommendations of 30 min of PA per day or 150 min of moderate-intensity activity per week (American Heart Association, 2014). Thus, our finding that PA readiness-to-change increased from PRE to POST suggests that LIFE was an effective tool to promote PA behavior change.

Furthermore, in the present study PRE health status was a significant predictor of self-efficacy for change in PA barriers. Health status is commonly cited as one of the major barriers for meeting PA recommendations among OA (American College of Sports Medicine, 2009). Low self-efficacy is also a barrier that may limit PA participation in OA (Dionigi, 2007). However, concern about health is also documented as a motivator for OA to engage in PA (Costello et al., 2001). In the present study, the interaction between PRE health status and PRE PA readiness-to-change significantly influenced the change in PA self-efficacy that was detected, with those rating their health and readiness-to-change higher also experiencing greater PA self-efficacy change. These results support the current research that demonstrates that PA programs that increase self-efficacy lead to increased PA participation (French et al., 2014).

Limitations

Generalizability is limited due to the relatively homogeneous sample of mostly White, female participants. Also, the education level and cognitive status of participants was not assessed. The results reported here might have been moderated by these factors. Additionally, the tools used may not have been sensitive enough to detect changes throughout the study for highly-functioning community-residing OA. The LIFE program did not include a control group because it was offered in a real-life, community-based setting. It is unsure if the results found were based solely on the LIFE program or if the LIFE program served as a means for participants to be encouraged to seek other ways of being physically active. Furthermore, all data were self-reported, which limits interpretation of findings. Finally, the POST measures were completed by participants on the last day the LIFE program met; therefore, some of the changes detected may be directly related to the fact that participants were active in the LIFE program, rather than making a lifestyle change.

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