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### Title

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### Permalink

<https://escholarship.org/uc/item/1vs7s7hq>

### Journal

Games for health journal, 3(4)

### ISSN

2161-783X

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### Publication Date

2014-08-01

### DOI

10.1089/g4h.2014.0006

Peer reviewed

# Adherence to a Videogame-Based Physical Activity Program for Older Adults with Schizophrenia

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## Abstract

**Objectives:** Adults with schizophrenia are a growing segment of the older adult population. Evidence suggests that they engage in limited physical activity. Interventions are needed that are tailored around their unique limitations. An active videogame-based physical activity program that can be offered at a treatment facility can overcome these barriers and increase motivation to engage in physical activity. The purpose of this report is to describe the adherence to a videogame-based physical activity program using the Kinect<sup>®</sup> for Xbox<sup>®</sup> 360 game system (Microsoft<sup>®</sup>, Redmond, WA) in older adults with schizophrenia.

**Materials and Methods:** This was a descriptive longitudinal study among 34 older adults with schizophrenia to establish the adherence to an active videogame-based physical activity program. In our ongoing program, once a week for 6 weeks, participants played an active videogame, using the Kinect for Xbox 360 game system, for 30 minutes. Adherence was measured with a count of sessions attended and with the total minutes attended out of the possible total minutes of attendance (180 minutes).

**Results:** Thirty-four adults with schizophrenia enrolled in the study. The mean number of groups attended was five out of six total (standard deviation = 2), and the mean total minutes attended were 139 out of 180 possible (standard deviation = 55). Fifty percent had perfect attendance.

**Conclusions:** Older adults with schizophrenia need effective physical activity programs. Adherence to our program suggests that videogames that use the Kinect for Xbox 360 game system are an innovative way to make physical activity accessible to this population.

## Background

PEOPLE WITH SCHIZOPHRENIA have low levels of physical activity, and low levels of physical activity contribute to poor health outcomes.<sup>1-6</sup> People with schizophrenia have a higher mortality rate than the general population, and the low levels of physical activity contribute to this mortality gap.<sup>7,8</sup> Physical activity promotes better mental and physical health outcomes.<sup>9-11</sup> Even short periods of low-intensity physical activity can positively influence mental and physical health.<sup>12</sup>

In a recent Cochrane review, the efficacy of three physical activity randomized controlled trials (e.g., walking, weight training) in people with severe mental illness was evaluated.<sup>9</sup> The authors concluded that the impacts of these programs on health outcomes were mixed, but some studies provided evidence of physiological (e.g., improved fitness) and psychological (e.g., less severe psychiatric symptoms) benefits from physical activity in people with schizophrenia. However,

randomized controlled trials that compared physical activity interventions with standard care (e.g., information about exercise) failed to demonstrate changes in specific health outcomes (e.g., body mass index, blood pressure). Two physical activity randomized controlled trials for people with severe mental illness published after the Cochrane review also produced mixed outcomes. One study provided evidence of a positive impact on weight change but failed to demonstrate changes in blood pressure.<sup>13</sup> The other study showed a positive impact on cardiorespiratory fitness (measured by the 6-minute walk test) but no significant difference between groups for weight loss or body mass index.<sup>14</sup>

These inconsistent findings may be related to the low adherence with the interventions. Promoting adherence to physical activity programs in people with severe mental illnesses is a challenge.<sup>9,15,16</sup> Reasons for difficulty with adherence include transportation problems,<sup>17</sup> physical illness,<sup>17</sup> and feeling uncomfortable in an exercise setting.<sup>18</sup> Providing activity

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programs in mental health facilities<sup>13</sup> and incorporating social support increase the success of the programs.<sup>19</sup> In addition, the presence of negative symptoms (e.g., emotional and social withdrawal), lack of knowledge about the benefits of physical activity, low self-efficacy, and social isolation correlate with lower physical activity participation.<sup>20</sup> In order for a physical activity program to create significant and lasting positive impacts on health outcomes, adherence with the program is critical. Because standard physical activity interventions have failed to improve important health outcomes, a novel intervention, like a videogame-based physical activity program designed to improve adherence, is needed in people with severe mental illness.

Videogames with an interface that requires physical exertion to play, such as the Kinect<sup>®</sup> for Xbox<sup>®</sup> 360 game system (Microsoft<sup>®</sup>, Redmond, WA), promote physical activity.<sup>21,22</sup> Participants use their body to control the game via the Kinect's full-body tracking sensor system that recognizes the participant's body and mirrors those movements in the game.

Videogames can make physical activity more appealing and engaging for people of all ages and can increase daily activity levels.<sup>23</sup> A videogame-based physical activity program that provides progressively more difficult challenges keeps players engaged and motivated over extended periods of time. Videogame research illustrates that as people become more involved and successful with active videogames, they develop skills that make it easier to engage in activity and experience more physical and emotional well-being.<sup>23</sup> Furthermore, active videogames may serve as a gateway to activities that lead to a more physically active lifestyle.<sup>23</sup> Evidence from research in the field of videogames indicates that active gameplay improves physical/physiological outcomes (such as increased energy expenditure),<sup>23</sup> psychological well-being,<sup>24</sup> and neurocognitive function.<sup>21</sup> Videogame-based physical activity minimizes barriers to activities found

in traditional physical activity programs for people with schizophrenia.<sup>25,26</sup> The activity is accessible at a mental health facility, is social, and minimizes the fear of stigma and disabling symptoms (e.g., paranoia) that can prevent participation in community programs. In this report, we describe adherence to our videogame-based physical activity program.

## Materials and Methods

### Theoretical framework

Figure 1 illustrates a model of the major ways that active videogames may lead to improved health behaviors and outcomes.<sup>23</sup> This model was originally developed by Dr. Debra Lieberman, Director of the Health Games Research national program.

This theory-based model illustrates a few ways that active videogames may improve health behaviors by influencing mediating factors (i.e., self-concepts; self-efficacy; physical skills, fitness, and well-being; and communication and social support) that are known to lead to behavior change. There are many other mediating factors that might appear in the model, depending on the behavioral goals of the game, so game design teams must revise the model to reflect the particular game design strategies they are using that can lead to specific changes in a mediating factor that in turn can lead to a desired health behavior and health outcome (Lieberman, 2001).<sup>27</sup> The four mediating factors are:

1. *Self-concepts*: Playing active videogames may improve a player's self-concept. For example, through a variety of game dynamics, active videogames may reduce personal feelings of stigma, improve self-esteem, and reduce the social anxiety that may inhibit engagement in activities.



**FIG. 1.** Model of health outcomes with active videogames. Reproduced with permission from Debra Lieberman. Color images available online at [www.liebertonline.com/g4h](http://www.liebertonline.com/g4h)

2. *Self-efficacy*: Self-efficacy is the level of confidence an individual has about one's ability to carry out a specific behavior. Self-efficacy for a behavior such as engaging in vigorous activity for 5 or more minutes can increase after playing games several times a week for multiple weeks.
3. *Physical skills, fitness, and well-being*: Active-play videogame researchers suggest that as people become more involved and successful with active-play games and develop skills that make it easier to engage in activity. Game players enjoy the perception that their bodies are becoming more fit and experience more physical and emotional well-being. Therefore, the rewards and benefits provide motivation for more engagement in physical activity.
4. *Communication and support*: When people play active videogames with others and share this experience, they often begin talking more about their workouts and their health with family and friends. This communication leads to encouragement, praise, coaching, sharing thoughts and feelings, and giving and receiving social support for being physically active—all elements known to improve health behaviors.

### Design

A descriptive longitudinal design was used to examine the adherence to our program. Institutional review board approval was obtained from the Committee on Human Research, University of California, San Francisco. Anonymity and confidentiality were maintained according to their guidelines.

### Participants and settings

Inclusion criteria were that participants be (1) at least 55 years of age or older, (2) diagnosed with schizophrenia or schizoaffective disorder, and (3) competent to consent based on an evaluation of their comprehension of the consent form. A convenience sample of participants from four different facilities was recruited by facility staff and referred to the researchers. Study fliers were also posted. Patients with a history of a prior myocardial infarction, uncontrolled hypertension, history of angioplasty, history of angina, and/or use of nitroglycerin to treat angina were excluded.

### Procedures

Recruitment and data collection began in May 2012 and concluded in June 2013. The Principal Investigator and her research staff facilitated the weekly sessions. Once a week for 6 weeks, participants played an active videogame, using the Kinect for Xbox 360 game system, for 30 minutes. Although current recommendations for adults are to engage in moderate intensity physical activity 150 minutes each week,<sup>11</sup> the focus of the pilot study was to determine feasibility, acceptability, and adherence to the program. Therefore, we chose a short frequency and duration for our program to first establish the feasibility of the program.

At each weekly session, participants choose from a variety of games and were encouraged to use a different game each week. Off-the-shelf videogames played included "Kinect Sports" (including bowling, golf, skiing, and darts), "Kinect Carnival Games," "Kinect Dance Central 2," "Kinect Adventures," and "Kinect Your Shape Fitness Evolved."

Games played most often included bowling, dance, carnival games, skiing, Tai Chi (from the "Fitness" game), baseball, darts, golf, river rafting, and 20,000 leaks under the sea.

Participants engaged in the program in groups of three or four at a time. The program took place at the facility the person attended: an outpatient community treatment center, a locked mental health facility, a transitional residential facility, and a skilled nursing facility.

Each participant had an appropriate amount of space in order to achieve full range of motion. Approximately 6 feet of free space between the participant and the Xbox Kinect sensor was needed. The games offered a variety of levels, and each group started off at the beginner level. Participants were taught warning signs to be aware of while exercising (i.e., shortness of breath, dizziness), were encouraged to discontinue the game if they noticed any exercise warning signs and to notify the research staff.

### Measures

A demographic questionnaire obtained information on age, gender, race, smoking status, and living situation at enrollment.

The theoretical model (Fig. 1) guided the design of the study. In addition to study staff observations of participants, acceptability was measured with a questionnaire that included open-ended questions. Examples of the questions include "What was your favorite game and why?" and "What was your least favorite game and why?" The open-ended responses to these questions provided additional information.

Adherence was measured with a count of sessions attended and with total minutes attended out of the possible total minutes of attendance. Total possible minutes for the six sessions was 180. The Principal Investigator or her assistant logged the participant's attendance at the session. The Principal Investigator or research assistant monitored participants throughout the session in order to determine the number of minutes attended as participants were allowed to leave at any point during the group.

Mobility was measured objectively with the Timed Get Up and Go (TGUG) test at enrollment and program completion. The TGUG is a valid and reliable test for quantifying functional mobility and following clinical change over time.<sup>28</sup> The test is quick, requires no special equipment, and is easy to administer. During the test, the person is observed and timed while she or he rises from an armchair, walks 3 m, turns, walks back, and sits down again. A continuous score in seconds for time needed to complete the task is recorded. Greater time reflects poorer functional mobility. A time of 12 seconds or less to complete the TGUG can be used to identify normal mobility in community-dwelling adults and to differentiate fallers from nonfallers.<sup>29,30</sup>

Mobility was measured subjectively with the physical function items from the SF-12 at enrollment and program completion. The SF-12 is a generic measure of health status. This scale was developed to be a shorter yet valid alternative to the SF-36.<sup>31</sup> The SF-12 includes one or two items from each of the following eight health concepts: Physical functioning, role limitations due to physical health problems, bodily pain, general health, vitality (energy/fatigue), social functioning, role limitations due to emotional problems, and

mental health (psychological distress and psychological well-being). The SF-12 takes about 2 minutes to administer and generates a score that ranges from 0 to 100, with higher scores indicative of better health status. These scores have been standardized for the general population. For example, a score of 50 reflects an average level of physical health, and each 10-point change in score reflects 1 standard deviation.

#### Data analysis

Statistical analyses were performed using SPSS (Chicago, IL) software. Descriptive statistics and frequency distributions were generated for sample characteristics. Pearson's bivariate correlations (two-sided) were conducted on the entire sample. One simultaneous regression model was used for an exploratory analysis of the relationship between total minutes attended and mobility. Predictor variables that were highly correlated with one another ( $r > 0.8$ ) were not included in the same model as a means of limiting collinearity. Alpha was set to  $p < 0.05$ .

TABLE 1. CLINICAL CHARACTERISTICS OF THE SUBJECTS

Characteristic	Mean or ratio (SD)
Age (years)	61.0 (4.6)
TGUG test (seconds)	
At enrollment <sup>a</sup>	12.3 (4.5)
At completion <sup>b</sup>	
SF-12 Physical Function summary score	12.1 (3.4)
At enrollment <sup>c</sup>	42.0 (10.8)
At completion <sup>d</sup>	39.5 (11.8)
Male	25/34
Smoking status	
Current	16/34
Past	13/34
Never	5/34
Residence	
With family	1/34
Apartment with roommate	4/34
Apartment alone	1/34
Board and care	12/34
Hotel	2/34
Homeless	2/34
Psychiatric facility	5/34
Long-term care	7/34
Race	
White	24/34
African American	4/34
Latino	1/34
Asian	1/34
Native American	2/34
Other	2/34

<sup>a</sup>Twenty-seven participants completed the Timed Get Up and Go (TGUG) test at enrollment.

<sup>b</sup>Twenty-four participants completed the TGUG test at completion of the program.

<sup>c</sup>Twenty-seven participants completed the SF-12 at baseline.

<sup>d</sup>Twenty-three participants completed the SF-12 at completion of the program.

SD, standard deviation.

## Results

In total, 34 participants were included in the analyses. Sociodemographic and clinical characteristics are presented in Table 1. The majority of participants were male, and the average age was 61 years. More than half of the patients were current or previous smokers.

Preliminary findings are useful for the theoretical model (Fig. 1) that guided the design of the study and further, more rigorous research is needed to measure effects of active gameplay on mediating factors and subsequently on health behaviors and health outcomes. For the self-concept factor, after participants attended one or more sessions, they played the games without reticence and were eager to try new and different activities. Participants talked about how participation improved their quality of life and gave them something to look forward to each week. In terms of self-efficacy, near the end of our 6-week study, most of the participants wanted to play the games longer or wanted to have more frequent turns. For the physical skills, fitness, and well-being factor, several participants in our pilot study reported to study staff that they engaged in more physical activity outside of the weekly 30-minute game session (e.g., attending community exercise classes, taking more walks). Finally for the communication and support factor, a key component to the success of our pilot study was the group atmosphere. Many participants indicated they enjoyed the program because they played the games with a group of peers. They enjoyed cheering for each other and coaching each other to do better with the games.

The mean number of groups attended was five out of six total (standard deviation = 2), and the mean total minutes attended were 139 out of 180 possible (standard deviation = 55). Seventeen participants (50 percent) attended all six sessions (perfect attendance), four participants attended five sessions, five participants attended four sessions, three participants attended three sessions, two participants attended two sessions, and three participants attended one session.

Thirty-two participants completed the program. Two participants were lost to follow-up or decided not to finish the program. There were no significant bivariate correlations between total minutes attended and age, sex, race, smoking status, or baseline TGUG.

We conducted further exploratory analyses on participants that completed the mobility assessments. Twenty-seven participants completed the TGUG and the SF-12 at enrollment. Twenty-four participants completed the TGUG at the end of the 6-week program. Twenty-three participants completed the SF-12 at completion. There was a significant association between the enrollment Physical Function summary score ( $r = 0.61$ ,  $P = 0.001$ ) and total minutes attended. There was a modest, but not significant, association between TGUG score at the end of the 6-week program and total minutes attended ( $r = -0.35$ ,  $P = 0.09$ ). The associations between the Physical Function summary score at completion ( $r = -0.01$ ) and TGUG score at enrollment ( $r = -0.1$ ) with minutes attended were not significant.

Results of the simultaneous multiple regression are given in Table 2. The 27 participants who completed the TGUG and SF-12 at enrollment were included in the analyses. Physical function summary subscores and TGUG scores were included as predictors in the model. With two

TABLE 2. THE EFFECT OF MOBILITY ON ADHERENCE

Source	R <sup>2</sup>	B	95% CI		R <sup>2</sup> change (sr <sup>2</sup> )	df	F	P
			Upper bound	Lower bound				
Overall	0.39					2, 24	7.52	0.003
Intercept		61.42	132.15	-9.31				
PF subscore		2.53	3.89	1.16	0.38	1, 24	14.65	0.001
TGUG		-1.10	2.17	-4.37	0.01	1, 24	0.48	0.50

CI, confidence interval; PF, Physical Function; TGUG, Timed Get Up and Go.

predictors in the model, 39 percent of the variation in total minutes attended was explained ( $P=0.003$ ). Physical Function subscore made a significant unique contribution to the model ( $P=0.001$ ).

### Discussion

Older adults with schizophrenia need effective physical activity programs that can be offered in the context of their treatment milieu. Videogames that use the Kinect for Xbox 360 game system are an ideal way to promote physical activity in this population because they can be offered on-site. Adherence results from this pilot physical activity program reveal that older adults with schizophrenia attended most of the sessions, and half of the participants attended all of the sessions. Total minutes attended were associated with better self-reported mobility at enrollment. This suggests that better mobility at the start of the program may be associated with better adherence. The lack of significant associations with gender and age suggests that men and women of all ages with schizophrenia may find our program acceptable. Also, the lack of association with baseline TGUG scores suggests that impaired mobility does not preclude participation at the start of the program.

Previous physical activity programs for people with schizophrenia have not been consistently effective at improving important health outcomes, and this may be due to problems with adherence.<sup>9,14,32</sup> The adherence findings from two recent physical activity randomized controlled trials in younger adults with schizophrenia provide some context for our findings.<sup>14,32</sup> The interventions (group exercise classes or a health club membership plus a health mentor) in both programs were offered for a year. In the program that offered group exercise classes,<sup>32</sup> adherence to the program was higher during the first 6 months (median number of total attended sessions was 30 out of a median of 61 sessions offered) than during the last 6 months (median of 24 sessions attended out of a median of 141 sessions offered). For the program that provided a health club membership plus a health mentor,<sup>14</sup> only 40 percent ( $n=27$ ) of participants attended a minimum of half of their weekly visits to the health club during the 12-month program. In our program, 50 percent of our participants attended all six sessions. Although our pilot program was offered for a shorter duration, the results suggest that our program strengthened adherence.

Offering a physical activity program within the context of a reinforcing videogame is a promising avenue for increasing physical activity during normally sedentary times, such as watching television.<sup>33</sup> Our intervention required no special

athletic attire, was an appealing way to begin a physical activity program, and provided the opportunity to experience novel activities in a safe environment. A qualitative study that included interviews with 16 older adults with schizophrenia found that participants expressed interest in group activities they could do in a safe environment at a comfortable intensity level. The Kinect for Xbox 360 videogame system is the ideal approach to meet these patients' needs. Active videogames provide light- to moderate-intensity physical activity.<sup>23,24,34,35</sup> Rather than starting a vigorous physical activity program, it is more reasonable and feasible for an adult with schizophrenia to begin with activities that provide light- to moderate-intensity physical activity.<sup>26</sup> Other studies found that participants without schizophrenia enjoyed active videogames more than traditional exercise (e.g., treadmill).<sup>24,35</sup>

Maximization of mobility may help delay disability and maintain independent life in older adults.<sup>36</sup> Mobility can be defined as the ability to move independently around the environment and is central to many basic and instrumental activities of daily living (i.e., activities of daily living and the Instrumental Activities of Daily Living Scale).<sup>37</sup> The multitude of chronic medical conditions experienced by people with schizophrenia, such as arthritis and chronic obstructive pulmonary disorders, can jeopardize optimal mobility. In addition, poor mobility increases a person's risk for medical comorbidities, such as diabetes.<sup>1</sup> Numerous studies in older adults illustrate that physical exercise has a positive impact on mobility.<sup>38,39</sup> Future research should test whether a videogame-based physical activity program will improve mobility in people with schizophrenia.

Our study has several limitations. In future work, we will focus on recruiting more women and a racially diverse sample by expanding to different sites and different communities. We did not include a control group assigned to play non-active videogames. A sedentary videogame control group would help tease out the impact of being engaged in a group activity on adherence and health outcomes. In addition, our program was only offered 30 minutes a week once a week. In order to achieve important health benefits, such as reduced body mass index and lower blood pressure, the program should be offered at least 150 minutes each week.<sup>11</sup> Despite the limitations, our study provides important preliminary data about the adherence to a novel videogame-based physical activity program that has potential to improve physical activity and health outcomes in people with schizophrenia.

Further work is needed to determine the impact of our program on health outcomes, such as blood pressure and

body mass index. Future work should also include the recruitment of a more diverse population and expanding the frequency and duration to further evaluate the efficacy in a real-world setting. The program may also be beneficial for younger adults with schizophrenia because they are also known to have multiple medical comorbidities and are at risk for mobility deficits.

This is an important first step toward the creation of a novel and effective physical activity program for people of all ages with a severe mental illness.

### Acknowledgments

This work was supported by the National Center for Research Resources (grant KL2R024130 to H.L. and UCSF-CTSI grant UL1 RR024131).

### Author Disclosure Statement

No competing financial interests exist.

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