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A pilot trial of a videogame-based exercise program for methadone maintained patients

Christopher J. Cutter, Ph.D.^{a,b,*}, Richard S. Schottenfeld, M.D.^a, Brent A. Moore, Ph.D.^a, Samuel A. Ball, Ph.D.^a, Mark Beitel, Ph.D.^{a,b}, Jonathan D. Savant, B.S.^b, Matthew A. Stults-Kolehmainen, Ph.D.^c, Christopher Doucette, B.A.^b, and Declan T. Barry, Ph.D.^{a,b}

^aYale University School of Medicine, Department of Psychiatry, New Haven, CT 06511 United States

^bPain Treatment Services, APT Foundation, Inc., New Haven, CT 06519 United States

^cNorthern Illinois University, IL 60115 United States

Abstract

Few studies have examined exercise as a substance use disorder treatment. This pilot study investigated the feasibility and acceptability of an exercise intervention comprising the Wii Fit Plus™ and of a time-and-attention sedentary control comprising Wii™ videogames. We also explored their impact on physical activity levels, substance use, and psychological wellness. Twenty-nine methadone-maintained patients enrolled in an 8-week trial were randomly assigned to either Active Game Play (Wii Fit Plus™ videogames involving physical exertion) or Sedentary Game Play (Wii™ videogames played while sitting). Participants had high satisfaction and study completion rates. Active Game Play participants reported greater physical activity outside the intervention than Sedentary Game Play participants despite no such differences at baseline. Substance use decreased and stress and optimism improved in both conditions. Active Game Play is a feasible and acceptable exercise intervention, and Sedentary Game Play is a promising time-and-attention control. Further investigations of these interventions are warranted.

Keywords

opioid-related disorders; exercise; video games; methadone

1. Introduction

Exercise participation is associated with improvements in physical (Berlin & Colditz, 1990; Franco et al., 2005; Garber et al., 2011; Helmrigh, Ragland, Leung, & Paffenbarger Jr, 1991; Hu et al., 2004; Lawlor & Hopker, 2001; Mead et al., 2010; Penedo & Dahn, 2005) and

Correspondence concerning this article should be addressed to: Christopher Cutter, Yale University School of Medicine, 495 Congress Avenue, 2nd Floor, New Haven, CT 06519. Phone: 203-285-2717; Fax: 203-781-4681; christopher.cutter@yale.edu.

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mental health outcomes among non-clinical and clinical samples (Armstrong & Edwards, 2003; Babyak et al., 2000; Bosscher, 1993; DiLorenzo et al., 1999; Doyne et al., 1987; Dunn, Trivedi, Kampert, Clark, & Chambliss, 2005; Goodwin, 2003; McNeil, LeBlanc, & Joyner, 1991; Mead et al., 2010; Pinchasov, Shurgaja, Grischin, & Putilov, 2000; Sexton, Mære, & Dahl, 1989; Singh, Clements, & Fiatarone, 1997; Veale et al., 1992). Exercise interventions also are promising for the treatment of substance-use disorders. To date, published research on the potential therapeutic effects of exercise in patients with substance-related disorders has focused largely on nicotine dependence, where it has been shown that physical activity reduces cigarette craving (Hassova et al., 2012) and may assist in smoking cessation (Pekmezi, Carr, Barbera, & Marcus, 2012; Zschucke, Heinz, & Ströhle, 2012).

Few studies have examined exercise interventions as a treatment for alcohol or drug use disorders (Pekmezi et al., 2012; Ussher, Taylor, & Faulkner, 2012; Zschucke et al., 2012). Most of these have used aerobic (e.g., running) or anaerobic (e.g., strength training) interventions performed on specialized equipment under the supervision of an exercise specialist (Bize et al., 2010; Brown et al., 2009; Brown et al., 2010; Buchowski et al., 2011; Dolezal et al., 2013; Donaghy, 1997; Kinnunen et al., 2008; Marcus et al., 2005; Palmer, Vacc, & Epstein, 1988; Roessler, 2010; Sinyor, Brown, Rostant, & Seraganian, 1982; Ussher, West, McEwen, Taylor, & Steptoe, 2003). Control conditions in these trials have varied; most used treatment as usual controls and did not control for the time and attention of the exercise intervention (Bize et al., 2010; Brown et al., 2009; Brown et al., 2010; Donaghy, 1997; Kinnunen et al., 2008; Marcus et al., 2005; Palmer et al., 1988; Roessler, 2010; Sinyor et al., 1982; Ussher et al., 2003), although an ongoing multi-site study evaluating a thrice-weekly, one-on-one supervised vigorous exercise intervention initiated during residential drug treatment is using a health education time-and-attention control (Stoutenberg et al., 2012; Trivedi et al., 2011).

To date, clinical trials of the efficacy of exercise in reducing substance use have faced three challenges: 1) low exercise adherence, 2) difficulty devising a credible time-and-attention control condition, and 3) high cost of interventions involving specialized exercise equipment, personnel, or facilities which may not be feasible to implement in many substance abuse treatment programs. We attempted to address these challenges by conducting a pilot investigation of an innovative, engaging, inexpensive, and transportable onsite exercise intervention in an outpatient methadone maintenance treatment (MMT) setting, where frequent attendance would facilitate regular on-site participation. Our primary aim was to assess the feasibility (i.e., adherence to the exercise regimen and retention) and acceptability (i.e., satisfaction) of the Wii Fit Plus™ exergames (i.e., videogames that require physical exertion), called “Active Game Play,” in comparison to a sedentary, time-and-attention control condition involving Wii™ sedentary videogames that are played while sitting, called “Sedentary Game Play.” Our secondary aim was to assess whether Active Game Play was associated with significant energy expenditure and, as compared with Sedentary Game Play, higher levels of exercise participation outside of the clinic. We also examined whether illicit substance use decreased and psychological wellness (i.e., perceived stress, optimism, psychiatric symptomology, life satisfaction) increased in Active Game Play and Sedentary Game Play participants over the course of the 8-week randomized pilot study.

2. Materials and methods

2.1. Participants

Participants were 29 patients receiving MMT at the APT Foundation, Inc., a non-profit community-based organization that specializes in the treatment of opioid dependence. Study inclusion criteria included an ability to read and understand English and past-week use of illicit opioids or cocaine as evidenced by self-report or urine toxicology findings. Individuals were excluded if they: 1) exhibited current suicide or homicide risk, 2) were unable to complete the informed consent procedures or baseline assessments due to psychiatric or cognitive impairment, 3) had a known seizure disorder, or 4) had a medical condition that would interfere with daily, low-to-moderate physical exercise (e.g., advanced cellulitis, acute musculoskeletal injuries).

Enrollment for the study began on February 15, 2010 and ended on December 31, 2011. As shown in Figure 1, twenty-nine of the 124 individuals screened were determined to be eligible for the study, provided written informed consent, and were randomly assigned to receive either Active Game Play or Sedentary Game Play. Forty-three patients initially indicated interest but subsequently declined to participate when they were contacted to schedule a study appointment. Fifty-two patients were deemed ineligible due to: absence of illicit opioid or cocaine use within the past seven days ($n = 44$); a known seizure disorder ($n = 2$); discharge from the MMT program ($n = 3$); and contraindicated medical conditions ($n = 3$). The study was approved by the Human Investigation Committee of the Yale University School of Medicine and the APT Foundation Board. Research assistants conducted all baseline (pre-intervention), weekly (post-randomization), and end-point (8 weeks following randomization) assessments. Participants were provided compensation of \$15 for weekly assessment completion (but were not remunerated for video game play session attendance).

2.2. Interventions

Participants received standard treatment at the MMT program, which consisted of: counseling group attendance at least once per month and daily methadone medication as prescribed. Participation in this study did not fulfill the clinic's monthly group attendance requirement. All randomized participants were provided access to Active Game Play or Sedentary Game Play in a private office on a research unit adjacent to the MMT clinic. A member of the research team conducted an orientation session, which consisted of providing (1) the intervention rationale: participants were informed that the purpose of each intervention was to decrease substance use and promote health by regular engagement in a physical activity [Active Game Play] or a non-drug-related pleasurable activity [Sedentary Game Play]; (2) logistical information (location, frequency, duration of study appointments); and (3) a demonstration, which included guiding participants through their initial use of the intervention. On each occasion that participants used the Wii™, a research assistant was available to answer questions, assist them, and monitor intervention adherence. In the Active Game Play condition, the research assistant recorded the session length, the Wii Fit Plus™ report of the mode and duration of the exercise activity (e.g., running), as well as the associated energy expended (i.e., kilocalories burned). The participant's weight was measured and recorded weekly by the Wii Fit Plus™ body test system. Each participant

created a Wii Fit Plus™ avatar called a “Mii.” Avatars in video games are visual representations of game players’ selves, which may foster player engagement (Jin, 2009).

2.2.1. Active Game Play—The Wii Fit Plus™ includes four categories of exergames (Aerobics, Strength, Balance, and Yoga) that dovetail with the four types of exercises recommended by the American College of Sports Medicine and the American Heart Association public health guidelines for a balanced, moderate intensity exercise program: aerobic, resistance, flexibility, and neuromotor exercises (Garber et al., 2011; Haskell et al., 2007). Each Wii Fit Plus™ category contained a variety of exergames from which participants were free to choose. Participants were required to include two Aerobic, one Strength, one Balance, and one Yoga activity in each Active Game Play session. Completion of the five activities was planned to take between 20 and 25 minutes, and participants were instructed to complete one session daily, Monday through Friday.

2.2.2. Sedentary Game Play—Participants in Sedentary Game Play chose from an assortment of Wii™ video games (i.e., Super Mario Brothers™, Hollywood Squares™, Tetris Party™, Jeopardy™, The Price is Right™), which were selected by the researchers because they appeared to be engaging, offered variety, required minimal physical exertion, and could be performed while sitting. Similar to Active Game Play, completion of the Sedentary Game Play session was planned to take between 20 and 25 minutes, and participants were directed to attend one session daily, Monday through Friday.

2.3. Measures

2.3.1. Acceptability—Participants rated their satisfaction with the intervention weekly using a 4-item Likert-type scale from 1 (“strongly disagree”) to 7 (“strongly agree”) measuring respondents’ perceptions of enjoyment (i.e. “I enjoyed the sessions this past week”), usefulness (i.e., “I found the sessions to be useful”), accomplishment (“I feel like I accomplished something during the sessions”), and motivation to continue (i.e., “I am looking forward to my next session”).

2.3.2. Physical Activity

In-session activity: Kilocalories (kcal), standardized units of energy expenditure, were collected and recorded from the Wii Fit Plus™ biodata system. Exercise intensity was expressed as metabolic equivalent of tasks or “METs.” Exergames have established MET values, whose accuracy has been supported by recent research (Graves et al., 2010; Miyachi, Yamamoto, Ohkawara, & Tanaka, 2010; Peng, Lin, & Crouse, 2011; Worley, Rogers, & Kraemer, 2011). To account for energy expenditure during times when subjects were not physically active, we also estimated kcals for intermittent time spent standing between exercises in Active Game Play as well as for sitting and gaming in Sedentary Game Play sessions. This calculation was performed using subjects’ weight, activity times, and MET values from the Compendium of Physical Activities, a well-established and centralized resource for identifying this information (Ainsworth et al., 2011). Height was measured at baseline using a stadiometer from a balance beam scale. Weight was measured each week using the Wii Fit Plus™ and was recorded in the Wii Fit Plus™ Body Test Program.

Extra-session activity: Levels of overall moderate-to-vigorous physical activity (MVPA) outside of the Wii sessions were measured weekly with the International Physical Activity Questionnaire-Long Version (IPAQ-L) (Booth, 2000), which assesses physical activity in five domains: work, transportation, house work, recreation, and time spent sitting. Across these divisions, the test-retest reliability in a large multi-national sample of adults was good (Spearman's $\rho = 0.81$), and agreement with accelerometry, an objective measure of physical activity, indicated fair to moderate criterion validity (Spearman $\rho = .33$) (Craig et al., 2003).

2.3.3. Substance Use—The Weekly Substance Use Inventory was administered weekly; using a procedure based on the Time Line Follow Back (Sobel & Sobel, 1992), a detailed day-by-day self-report of alcohol and drug use was collected. Urine toxicology screens were collected weekly; analyses were performed using a one-step immunochromatographic test (Redwood Toxicology Laboratory, Santa Rosa, CA). Tested metabolites included morphine (> 300 ng/ml cutoff), oxycodone (> 100 ng/ml cutoff), and cocaine (> 300 ng/ml cutoff).

2.3.4 Psychological Wellness Outcomes—Perceived stress was measured by the widely used Perceived Stress Scale (PSS) (Cohen, 1988). The PSS measures the degree to which situations in one's life are appraised as stressful. Items are designed to tap into how unpredictable, uncontrollable, and overloaded respondents find their lives. The scale also includes a number of direct queries about current levels of experienced stress.

Optimism was measured using the Life Orientation Test-Revised (LOT-R) (Scheier, Carver, & Bridges, 1994). Psychiatric symptomology was assessed by the Brief Symptom Inventory-18 (BSI-18) (Derogatis & Savitz, 2000). Life satisfaction was measured by the Brief Life Satisfaction Scale (BLSS) (Lubin & Van Whitlock, 2004). The BLSS is a 10-item assessment that measures a person's perception of the quality of their own lives and life satisfaction.

2.4. Data Analysis

The primary outcome measures were feasibility (intervention adherence and retention) and acceptability (self-reported satisfaction). Secondary outcome measures were: a) self-reported physical activity outside of the study interventions (i.e., IPAQ-L), b) energy expenditure (kcal) during sessions, c) illicit drug use (urine toxicology tests and days of self-reported drug use), and psychological wellness (i.e., perceived stress, optimism, psychiatric symptomology, life satisfaction). The statistical analyses evaluating differences between Active Game Play and Sedentary Game Play were exploratory due to the small sample size. Differences between groups on weekly urinalysis were evaluated using logit distribution general estimating equations (GEE) with autoregressive 1 (AR1) covariance structure. Missing urine specimens were coded as positive for opioids and cocaine. Analyses controlled for group differences in baseline substance use measures. Retention, as measured by days retained in treatment, was evaluated using Kaplan-Meier survival analysis. Linear mixed modeling (LMM), using AR1 covariance structure, was used to evaluate the number of sessions attended each week, weekly ratings of patient satisfaction, estimated calories expended per session, days of self-reported illicit substance use, and measures of psychiatric

symptomology, perceived stress, optimism, and life satisfaction. Moderate-to-vigorous physical activity (MVPA) scores outside the Wii Fit Plus™ sessions were log transformed (Hopkins, Marshall, Batterham, & Hanin, 2009) and evaluated using LMM with baseline scores as a covariate (comparable to ANCOVA).

3. Results

3.1. Participant Description

Table 1 presents baseline participant characteristics. Of the 29 participants, 59% were women; 38% identified themselves as African American, 45% as European American, 10% as Hispanic, and 7% as Native American. Forty-five percent were never married, 62% were unemployed, and 59% had completed high school. Close to half (48%) of the participants were obese (i.e., BMI ≥ 30). Compared to participants in Sedentary Game Play, participants in Active Game Play reported longer illicit opioid histories and more days of cocaine use in the past month, and they were more likely to be on probation or parole (all p 's < .05). Nine of 15 (60%) participants in Active Game Play reported 10 or more days of cocaine use in the past month, compared to only 1 of 14 (7%) in Sedentary Game Play. Only 1 participant (in Active Game Play) reported more than 3 days of illicit opioid use in the past month.

3.2. Feasibility and Acceptability

Table 2 presents feasibility and acceptability outcomes by study condition. Of the 29 individuals who initiated treatment, 27 (93%) completed the study (14 in Active Game Play; 13 in Sedentary Game Play), and on average, participants attended over 65% of the total number of scheduled intervention sessions (26.1 of 40 total). There were no significant differences between groups in days retained in treatment ($p = .34$) or the number of intervention sessions completed ($p = .47$). Patients in the Sedentary Game Play group participated on average for significantly more minutes per session than those in the Active Game Play group ($p < .01$), but the total number of minutes averaged more than the 20 minute minimum targeted for both groups.

All 27 participants who completed the study provided acceptability ratings. As shown in Table 2, the mean ratings for the four facets of acceptability were high in both conditions. A combined mean for the four acceptability items (i.e., "overall acceptability") was comparably high and did not differ between groups ($p = .99$), change over time ($p = .38$), or interact with time and condition ($p = .95$).

3.3. Physical Activity

3.3.1. In-session activity—We calculated energy expenditure during each session based on time spent on different activities. Based on the *Compendium of Physical Activities* (2011), Wii activities were coded for low to moderate exercise (3.0 METs), transitory standing or fidgeting (1.8 METs) or sedentary (1.3 METs). Active Game Play resulted in significantly more kcals expended per session ($M = 84.5$, $SD = 25.2$) compared to Sedentary Game Play ($M = 49.2$, $SD = 8.6$; $p < .001$, $d = 1.87$). Active Game Play kcals were based on 14.9 minutes ($SD = 2.2$) of exercise and 7.4 minutes ($SD = 1.4$) of transitory standing or

fidgiting. Thus, participants in the Active Game Play group expended approximately 35.3 kcal more than those in the Sedentary Game Play group.

3.3.2. Extra-session activity—Although the baseline differences in overall moderate-to-vigorous physical activity (MVPA) were not statistically significant (Active Game Play, $M = 10.7$, $SD = 9.4$ vs. $M = 9.1$, $SD = 10.7$ for Sedentary Game Play, $p = .57$), LMM analyses of group differences during treatment included baseline values. As shown in Figure 2, individuals in Active Game Play reported significantly higher levels of overall MVPA outside the Wii Fit Plus™ sessions based on the IPAQ-L than those in Sedentary Game Play ($M = 9.7$, $SD = 9.9$ hours per week versus $M = 4.0$, $SD = 5.2$ hours per week; $p = .005$; $d = .72$). The effect of time ($p = .48$) and the interaction between time and treatment group ($p = .27$) were not significant. Based on their weekly self-reported activity levels outside of the clinic, 3 participants (20%) in Active Game Play were classified as sedentary (< 2.5 MVPA hours per week) compared to 5 (36%) in Sedentary Game Play ($p = .43$). For other biometric measures of body weight and BMI, there were no significant condition effects (all p 's $> .07$), time effects (all p 's $> .22$), or condition by time effects (all p 's $> .19$).

3.4. Substance Use

Controlling for baseline differences in cocaine use and years of opioid use, there was a significant reduction in self-reported levels of illicit opioid or cocaine use over time ($p < .001$, from $M = 3.0$ days/week to $M = 1.7$ days/week, $d = .82$), but the reduction did not differ by group ($p = .39$, $d = .36$), nor was there a significant interaction with group by time ($p = .46$). Similarly, the mean percentage of the urine tests positive for illicit opioid or cocaine use did not differ significantly between groups ($p = .13$, $d = .49$), nor were there significant effects of time ($p = .40$) or interaction between time and treatment group ($p = .21$). The pattern of results was similar in analyses that used other assumptions regarding missing urine specimens (e.g., coding them as missing, coding them as positive only when patients were still receiving interventions, or carrying the last result forward).

3.5 Psychological Wellness

There was a significant decrease in perceived stress ($p = .04$, $d = .50$) and optimism ($p = .04$, $d = .35$) over time, but no significant differences between Active Game Play and Sedentary Game Play groups ($p = .54$, and $p = .29$, respectively), nor interactions of condition by time ($p = .92$ and $p = .40$, respectively). For psychiatric global symptomatology and life satisfaction, there were no significant condition (p 's $> .92$), condition by time (p 's $> .46$), or time effects (p 's $> .94$).

4. Discussion

This study is the first to demonstrate the feasibility and acceptability of an onsite substance abuse treatment exercise intervention involving the Wii Fit Plus™, called Active Game Play, and a sedentary, time-and-attention control involving the Wii™, called Sedentary Game Play. Active Game Play participants attended, on average, 3 sessions weekly over the course of the 2-month study; the study had a low attrition rate (7%). Participation in Active Game Play was associated with a high level of satisfaction and a reasonable level of in-session

energy expenditure. In comparison to participants in the sedentary control group, those in the exercise group reported higher levels of exercise outside of the clinic, despite comparable baseline levels of physical activity. Individuals in both conditions displayed similar decreases in illicit drug use, reduced stress perceptions, and increased optimism over the course of the study.

Adherence is important to the success of exercise interventions. However, differences in study design complicate the comparison of adherence rates across studies on substance use disorders (e.g., setting of the treatment and exercise intervention, attendance norms). The 60% adherence rate associated with Active Game Play (i.e., about 3 of the recommended 5 weekly sessions) suggests that there is still considerable room for improvement. Some studies have devised targeted adjunctive interventions to promote exercise adherence, including contingency management (Dolezal et al., 2013; Weinstock, Barry, & Petry, 2008) and a comprehensive behavioral intervention (Stoutenberg et al., 2012; Trivedi et al., 2011). Studies of exercise in substance use treatment have generally lacked rigorous control conditions (Brown et al., 2010; Sinyor et al., 1982; Weinstock et al., 2008). Sedentary Game Play is a promising exergame time-and-attention control condition. Similar to their Active Game Play counterparts, Sedentary Game Play participants exhibited high adherence and satisfaction.

Previous exergame studies have yielded mixed findings regarding changes in levels of non-intervention-related physical activity (Peng, Crouse, & Lin, 2013). We found, however, that not only did individuals in Active Game Play expend reasonable levels of physical activity by playing exergames, in contrast to those in Sedentary Game Play, they also maintained their levels of moderate-to-vigorous physical activity (MVPA) outside of the intervention over time. It is noteworthy that participants were not instructed to engage in physical exercise outside of the intervention.

This study had several limitations. The study had limited power to detect possible differences between study groups because of the small sample size ($n = 29$). Relatively low baseline levels of drug use among participants and baseline differences between the two groups with regard to cocaine use complicated detection of possible intervention effects on illicit drug use. Physical activity was assessed by self-reported measures; prior research has found that participants may over-report physical activity on self-report instruments (Prince et al., 2008; Sliotmaker, Chinapaw, Schuit, Seidell, & Van Mechelen, 2009). Independent measures of physical activity, such as accelerometers, would provide more objective data of physical activity outside the intervention (McMurray et al., 2004; Reilly et al., 2008). The Active Game Play subjects completed sessions faster than originally designed, since the participants learned to navigate the transition between games faster than originally anticipated. This resulted in subjects in Active Game Play spending significantly less time in the sessions than those in Sedentary Game Play. The exercise levels targeted and achieved by participants in Active Game Play did not meet those recommended in the ACSM guidelines (i.e., moderate-intensity cardiorespiratory exercise training for 30 minutes per day, five days a week for a total of 150 minutes per week), especially since participants did not engage in active exercise the entire time they used the Wii Fit Plus™ (Garber et al., 2011; Haskell et al., 2007). The Active Game Play intervention lasted 8 weeks, which is less

than the recommended ACSM minimal research trial duration of 10 weeks (Bhasin et al., 2000; Duncan, Gordon, & Scott, 1991; Fulcher & White, 1997; Meyer & Brooks, 2000; Stathopoulou, Powers, Berry, Smits, & Otto, 2006; Wing, Venditti, Jakicic, Polley, & Lang, 1998). The combined limitations in sample size, tendencies for over-reporting on self-report measures of physical activity, and insufficient intervention exercise dose may explain the lack of group differences in illicit drug use reduction despite the Active Game Play group's significant increase of physical exercise. Furthermore, reductions in illicit drug use and perceived stress and improvements in optimism that occurred during treatment in both treatment groups may reflect a common mechanism of behavioral activation and engagement in pleasurable activities with both Wii™ applications. Other possible explanations for the improvements across both treatment groups include participation more generally in the research and added treatments or regression to the mean. The study was conducted in an urban, large community-based methadone clinic in the northeast; therefore, findings may not generalize to other clinics or geographic areas. The high proportion of individuals who were assessed for eligibility and subsequently declined to participate may also affect the generalizability of the study findings. Finally, this study yielded insufficient group sizes to analyze the potential moderating effect of obesity (i.e., BMI > 30).

Despite these limitations, the results provide preliminary data indicating that physical exercise delivered via the Wii Fit Plus™ represents a novel, low-cost, transportable, feasible, and acceptable intervention for substance abuse treatment associated with high patient satisfaction and interest. Study findings suggest the merit of conducting a larger scale randomized clinical trial to examine the efficacy of Active Game Play in attenuating illicit drug use and increasing physical activity among patients with substance use disorders. To make Active Game Play more consistent with ACSM guidelines, future studies should increase Active Game Play session length (e.g., 50 minutes), and set defined weekly or daily targets for exercise completed outside the treatment environment (e.g., brisk walking for 30 minutes or more 2–3 times per week) (Garber et al., 2011). Methadone maintenance treatment settings may be an ideal venue for conducting this research because patients with ongoing illicit drug use are typically required to attend their program multiple days a week to receive their methadone, and they may exhibit a preference for low-demand services. The use of well-validated pedometers or accelerometers to provide an objective measure of physical activity is also recommended for future research of Active Game Play. Wearing pedometers and attending to their output may serve as a potent motivator for individuals to increase physical exercise (Bravata et al., 2007).

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Highlights

- Videogame exercise and sedentary, time-and-attention control conditions were tested
- Both conditions showed feasibility and acceptability in methadone-maintained patients
- Exercise was associated with greater offsite physical activity than sedentary control

Figure 1.
Participant flow in the study.

Figure 2.

Self-reported hours of weekly moderate to vigorous physical activity (MVPA) outside the clinic.

Notes: AGP = Active Game Play participants, SGP = Sedentary Game Play participants

Table 1

Baseline characteristics of study participants.

Demographic Information	Total (<i>n</i> = 29)	Active Game Play (<i>n</i> = 15)	Sedentary Game Play (<i>n</i> = 14)	<i>p</i>
Age, mean (SD)	43.4 (8.5)	42.8 (8.7)	44.0 (8.5)	0.71
Male, % (N)	41% (12)	47% (7)	36% (5)	0.55
White, % (N)	45% (13)	40% (6)	50% (7)	0.48
Unemployed, % (N)	62% (18)	73% (11)	50% (7)	0.06
Completed high school, (N)	59% (17)	53% (8)	64% (9)	0.55
Never married, % (N)	45% (13)	33% (5)	57% (8)	0.20
Obese (BMI > 30) (N)	48% (14)	40% (6)	57% (8)	0.36
On probation or parole (N)	18% (5)	36% (5)	0% (0)	0.01
Years of opioid use, mean (SD)	15.4 (10.7)	19.3 (11.9)	11.1 (7.4)	0.03
Days of opioid use, out of 30, mean (SD)	1.6 (5.2)	2.7 (7.1)	0.4 (0.9)	0.22
Years of cocaine use, mean (SD)	11.1 (10.6)	9.9 (10.6)	12.2 (10.9)	0.56
Days of cocaine use, out of 30, mean (SD)	8.6 (10.6)	12.6 (12.3)	4.3 (6.5)	0.03
Times in drug abuse treatment, mean (SD)	8.1 (10.1)	10.1 (9.3)	5.9 (5.5)	0.15

^a BMI = body mass index^b SD = standard deviation

Table 2

Feasibility and acceptability of exercise and control conditions.

Outcome measures	Active Game Play (n=14)		Sedentary Game Play (n=13)		p	Effect Size d
	Mean	SD	Mean	SD		
Feasibility						
Days retained in treatment protocol (out of 56)	53.1	11.4	56.0	0.0	.34	.36
Percent of Wii sessions completed	62.7	31.5	67.7	28.8	.47	.17
Number of minutes in session	22.3	3.4	24.8	3.6	.003	.71
Number of sessions completed (out of 40)	25.1	12.6	27.1	11.5	.47	.17
Acceptability						
Enjoyment (1–7 Likert-type scale)	6.4	1.3	6.4	0.4	.99	.0
Usefulness (1–7 Likert-type scale)	6.3	0.9	6.2	0.5	.86	.03
Accomplishment (1–7 Likert-type scale)	6.2	0.6	5.9	0.7	.11	.64
Motivation to continue (1–7 Likert-type scale)	6.1	1.1	6.5	0.4	.20	.50
Overall acceptability (1–7 Likert-type scale)	6.3	0.9	6.2	0.5	.99	.14