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# The Role of Exergaming in Improving Physical Activity: A Review

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## Abstract

**Background—**The high prevalence of obesity in America can be attributed to inadequate energy expenditure as a result of high levels of physical inactivity. This review presents an overview of the current literature on physical activity, specifically through active videogame systems (exergaming) and how these systems can help to increase physical activity levels.

**Methods—**The search strategy for this review was to identify previous studies which investigated energy expenditure levels using a single active video game or a combination of active videogames.

**Results—**Based on data from 27 studies, a strong correlation exists between exergaming and increased energy expenditure (up to 300% above resting levels). The majority of active videogames tested were found to achieve physical activity levels of moderate intensity, which meet American College of Sports Medicine guidelines for health and fitness.

**Conclusions—**Exergaming is a new and exciting strategy to potentially improve physical activity levels and reduce obesity among Americans.

### Keywords

Exercise; energy expenditure; videogaming; obesity

## INTRODUCTION

The prevalence of obesity in America has reached epidemic proportions. Currently, 69% of Americans are either overweight or obese.[1] Inadequate energy expenditure (EE) and excessive energy intake can lead to an increased risk of obesity, as well as, cardiovascular disease, diabetes and cancer.[2–4] These deleterious outcomes are significant risk factors for increased morbidity and mortality. The recommended amount of physical activity for Americans is ≥150 min/wk of moderate intensity, however, many Americans are not meeting these guidelines. For these reasons, there is a need for better strategies to help improve physical activity levels among Americans. Therefore, the purpose of this study is to


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present an overview of the literature on exergaming, a new genre of videogames that are geared towards promoting physical activity, and its effect on EE.

Americans spend significant amounts of time using screen-based media. Studies show that users spend up to 4 to 5 hours per day on computers, television, and videogames combined[5] and those engaging in more than four hours of screen-based activities per day also exercise less than the national recommendations.[6] Consequently, increased time in front of screen-based media contributes to a sedentary lifestyle.[7–10] Sadly, it is projected that in the near future, current screen time for children as well as adults is likely to increase.[5]

Because there is a correlation between screen-viewing activities and physical inactivity, computerized videogames that promote physical activity are continuing to be developed. Active videogame systems, such as Nintendo Wii and Xbox Kinect have recently gained in popularity. Researchers and developers have coined the term "exergaming," a relatively new type of entertainment that couples physical activity and video gaming.[11] Although exergaming has become well-known within the past few years, active videogames were first introduced nearly 30 years ago. For example, the Atari Joyboard, created in 1982, was a balance board controller which emulated the experience of slalom skiing. In addition, Powerpad by Bandai was a floor mat game in which players would step on large buttons to control gameplay. The PowerPad was very similar to games such as Dance Dance Revolution by Komani today.

Several studies have examined the benefits of exergaming and its the impact on health. The majority of these studies have focused largely on children and adolescents, thus biasing the results. It is therefore unclear whether exergaming is an appropriate strategy to help American children, as well as, adults, meet the American College of Sports Medicine (ACSM) guidelines for health and fitness. Since Americans spend a considerable amount of time using sedentary games, it is argued that by substituting exergames for sedentary games, physical activity levels can be improved. Thus, the purpose of this review is to present an overview of the current literature on exergaming and its effect on EE.

## METHODS

The search strategy for this review was to identify studies which investigated EE levels using a single active video game or a combination of active videogames. PubMed was the search engine that was utilized and the following key words were used: "active computer games," "active gaming," "active videogaming," "exergaming," "exertainment," and "new generation computer games." Studies could include any research population and could be of any study design (e.g., prospective, retrospective, etc.). Review articles and editorials were excluded; however, appropriate review articles were searched in order to locate additional relevant studies. A total of thirty-two articles were identified. Of these, five articles were excluded (1 review; 2 editorials). Twenty-seven studies published between 2002 and 2012 were reviewed.

## RESULTS

We identified 27 studies that assessed the effect of exergaming on EE. From these studies, overall findings showed a strong correlation between exergaming and increased EE. The majority of active videogames tested were found to achieve activity levels of moderate intensity, which meet ACSM guidelines for health and fitness. There was also evidence that suggested that exergames of longer duration may be more beneficial to help meet these recommendations. A summary of published studies examining the effect of exergaming on EE is shown in Table 1.

### Interactive Aerobic Fitness Games

Interactive aerobic fitness videogames have gained in popularity since the introduction of the Nintendo Wii gaming console. The Nintendo Wii is an active videogame that uses a wireless controller that allows the player to simulate a variety of different sports and activities. Similar to the Nintendo Wii is a gaming system called Xavi-X which also simulates sports and activities. A total of twelve published studies[12–23] examined the effect of interactive fitness games on EE. All twelve of the studies were acute effect studies, which collected data from one session of exergaming. The duration of exergaming sessions ranged from 8 minutes to 25 minutes in length. All but two studies measured EE using indirect calorimetry. One study used the Sensewear armband system, which measures EE using skin temperature and Galvanic skin response, while another study used the IDEEA (intelligent device for energy expenditure and activity) system. The IDEEA system determined EE by measuring type and intensity of physical activities. Results from all eleven studies found that EE significantly increased above resting levels while playing interactive fitness games. In a population of twelve Japanese adults, Miyachi et al.[13] showed that 33% of the activities using the Ninendo Wii met ACSM guidelines for moderate intensity physical activity following eight minutes of activity. Graves et al.[16] also found Nintendo Wii Fit activities to stimulate moderate physical activity levels in adolescents, young adults and older adults. Similar results were found in a study by Guderian et al.[19] in older adults.Graves et al.[15] studied thirteen children and found that EE using the Nintendo Wii was significantly greater (66.0 kcal/min) than that compared to rest (20.0 kcal/min) or with a sedentary videogame (27.6 kcal/min). In an earlier study by Graves et al.,[23] the differences between EE during Nintendo Wii play versus playing a sedentary videogame were examined. They found that among children aged 13–15 years old, EE was significantly higher than when playing sedentary videogames. Similar results were found by Leatherdale et al.,[22] Mitre et al.[21] and White et al.[20] who all compared Nintendo Wii activities to sedentary screen-time activities in children. Lanningham-Foster et al.[18] measured EE in adults and children while playing Nintendo Wii boxing, playing a sedentary videogame, watching TV, standing, sitting and while at rest. EE increased significantly above all other activities for both adults and children. The mean increase in EE in children above resting levels was 189±63 kcal/hr and in adults was 148±71 kcal/hr. Worley and colleagues[17] examined EE in healthy women while playing Nintendo Wii Fit games (hula and steps) at different activity levels. Results found that intermediate levels of both hula and steps produced EE equivalent to a walking speed of >3.5 miles/hour.

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Only one study investigated the gaming system, Xavi-X.[12] In this study, eighteen children aged 6–12 years old completed a gaming protocol which consisted of 5 minutes each of rest, a seated computer game, and Xavi-X. EE was found to be significantly higher while playing Xavi-X than when at rest or during the seated computer game. Specifically, EE increased above resting values up to 451% when playing Xavi-X.

## Motion Capture Technology Games

Ni et al.[24] examined the effect of the Sony EyeToy on physical activity levels. The Sony Eyetoy is a digital camera device, similar to a webcam, which creates a virtual gaming environment. In this study, twenty children 10–14 years of age were randomized into a Sony Eyetoy exergaming intervention or control group for 12 weeks. The children were required to wear accelerometers for four consecutive days at baseline, six weeks and twelve weeks. Accelerometers measure physical activity counts that are able to be converted to determine energy expenditure. Participants were asked to substitute non-active videogames with Sony Eyetoy exergames. Daily activity logs were also completed during this time to record videogame use (active and inactive), as well as, any other activities. Physical activity was found to be higher in the intervention group when compared to the control. The mean difference at 6 weeks between the intervention groups and the control was 194 counts per minute which is equivalent to light intensity physical activity (Mean difference at 6 weeks = 194 counts/min [95% C.I. −153, 187]).

## Dance Simulation Games

Dance simulation games, such as Dance Dance Revolution, (DDR) by Komani, are a group of video games that involve dancing to a set pattern and rhythm. Four of the five studies that evaluated dance simulation games were acute effect studies ranging from 10 to 30 minutes of exercise duration. All five studies assessed EE using indirect calorimetry with portable metabolic unit. In a study by Fawkner and colleagues[25] twenty adolescent girls were required to play a dance simulation game called ZigZag dance mat for 30 minutes. Results found significant increases in EE above resting levels (23.0 kcal/min and 80.0 kcal/min, respectively). Similar results were established by Tan et al.[26] who examined the effect of Konami DDR on healthy college students. Unnithan and colleagues[27] compared the effect of Konami DDR in overweight and non-overweight children. Results found that overweight children expended more energy while exergaming than non-overweight children (4.6±1.3 kcal/min vs. 2.9±0.7 kcal/min, respectively). Sell et al.[28] compared the effects of Konami DDR in college students who were experienced players with students who were inexperienced players. Experienced players who played at higher levels of difficulty achieved significantly greater total EE than inexperienced players during gameplay (315.5 kcal vs. 144.0 kcal, respectively). Similar results were found in a study by Stroud et al.[29]

## Interactive Cycling Games

The GameBike by Cateye is an exercise bike designed to work in concert with a variety of videogame consoles. Players control their speed of the videogame by pedaling and if the player stops, the game pauses or stops completely. In a study by Haddock et al.,[30] the effect of the Cateye GameBike was compared to a traditional stationary bike in overweight children. All participants exercised for one 20-minute session. Significant increases in EE above baseline were seen in both groups. Participants in the experimental group had significantly higher increases in EE than the control after 20 minutes of the Cateye GameBike. In this study, EE was measured using indirect calorimetry using a portable metabolic unit.

## Isometric Resistance Games

Isometric resistance games, such as the Exerstation by PowerGrid Fitness, use handheld controllers that require isometric resistance to control the game. One published study[11] examined the health effects of a Powergrid Fitness Exerstation on college males. In this study, 32 college-aged males were randomly divided into a control group using a traditional sedentary videogame or an experimental group using the Powergrid Fitness Exerstation. All participants were required to play videogames both alone and against a randomly assigned opponent for 30 minutes. Total EE was significantly greater in the Powergrid Fitness Exerstation group (61.58 kcal) when compared with the control group (32.44 kcal) after 30 minutes of gaming. Energy expenditure in this study was measured using indirect calorimetry.

## Exergaming Comparison Studies

Six studies determined the effects of an active videogame compared to at least one other active videogame. In a study by Maddison et al.,[31] 21 children were given five different exergames to choose from including: Sony Eyetoy (boxing), Homerun (baseball), Groove (dancing upper body), Anti-Grav (lower body) and Dance UK (dance simulation game). After 8 minutes of continuous exergaming, the boxing simulation game expended 6.5 kcal/min of energy compared with 6.0 kcal/min with Homerun, 4.9 kcal/min with Dance UK, 2.9 kcal/min with Groove and 3.6 kcal/min with AntiGrav. Similarly, Graf et al.[32] compared Nintendo Wii Sports and Konami DDR to walking on a treadmill at moderate intensity (5.7 mph). Results from this study found that EE levels with Nintendo Wii equaled that for moderate intensity walking (4.1 kcal/min, for both). Results from this study also found that playing Konami DDR (expended more energy (5.0 kcal/min) than Nintendo Wii or moderate intensity treadmill walking. Similar results were found in a study by Bailey et al.[33] Siegel et al.[34] compared the effects of playing 3 different exergames (Jackie Chan’s Studio Fitness Power Boxing, 3-kick, and Disney’s Cars Piston Cup Race on Cateye GameBike) for 30 minutes in a group of 13 healthy college students. Results from this study found that average EE during exercise with active videogames increased significantly above resting values (7.54 kcal/min and 1.39 kcal/min, respectively).

In a study by Lanningham-Foster et al.[35] high EE levels were found while playing Konami DDR. This study compared the effects of Konami DDR and Sony EyeToy to a traditional sedentary videogame. Results found that EE while playing Konami DDR was higher than that of Sony EyeToy and that EE was increased 108% above resting levels. In study by Lyons et al.[36] four types of exergames were compared including shooter, band simulation, dance simulation, and fitness games. Results from this study found that fitness and dance simulation games significantly increased EE above resting levels by 322% and 298%, respectively. All six of these studies used indirect calorimetry with a standard or portable metabolic system to measure EE.

## DISCUSSION

The purpose of this review was to present an overview of the currently available literature on exergaming and its effect on EE. All 27 studies included in this review exhibit the positive benefit of active videogaming on EE and its ability to meet national physical activity guidelines. The most noteworthy of these exergames were the dance simulation games which demonstrated the most significant increases of EE. Fawkner et al.[25] found increases in EE of 300% above resting levels with Konami DDR activity while increases of 108% have been reported with the Sony EyeToy[35] and 230% with the Nintendo Wii exergames.[15] The majority of the studies in this review were acute effect studies, ranging from 10 to 30 minutes of exercise per session. Results from these studies found that moderate-vigorous intensity exercise, as well as significant increases in EE[37] can be achieved after such short duration. Research shows that typical videogame play, however, lasts 1–2 hours,[38] suggesting that longer duration of exergaming could elicit even greater health benefits. In addition, because videogame play at home is at least an hour, lab-based studies may not replicate the use of exergaming at home. Therefore, even higher EE levels may be achieved in a home-based study. Active videogame use may also encourage longer exercise durations which can help to expend greater amounts of energy.

Only five studies measured the effect of exergaming in adults (≥18 years of age). Since physical activity levels among Americans are low and more adults are beginning to play videogames,[38] it may be of significance to more closely examine whether exergaming can be used to promote physical activity among adult populations. Furthermore, only 3 studies mentioned the ethnic makeup of their population. Of these, only one study included an African-American (n=1) in their study sample. Taking into consideration that the African-American and Latino population have the highest levels of obesity, physical inactivity and screen-viewing time[39] in the US, it may be advantageous to examine if exergaming is a potential method of increasing physical activity levels in these populations.

Newer exergaming systems, such as Sony Playstation Move and Microsoft Xbox Kinect, have yet to be studied. These systems have emerged with greater technologies which give the user a greater active gaming experience. The Sony Playstation Move, for example, uses a hand-held three-axis accelerometer to capture overall motion during gameplay. Microsoft Xbox Kinect is a hands-free device with full-body 3D motion capture, voice and facial recognition. Due to the advanced movement detection associated with such systems, the future of exergaming could have great possibilities. For example, people may be more likely to commit to and maintain an exercise regimen if they are actively engaged in a cognitive activity that they enjoy and that distracts them from the physical activity. In addition, people may be more likely to exercise longer if they have something to distract them from their exercise and thus expend greater amounts of energy.

In summary, the major findings of this review show that exergaming can increase EE to levels that meet the ASCM recommended guidelines for health and fitness. EE levels during exergaming may also depend on perception, as well as, exergaming experience. In addition, randomized controlled trials and home-based studies of longer duration are needed to determine the long term effects of exergaming on health and fitness. Future studies which investigate exergaming in more diverse populations such as adults and minorities are also needed. In conclusion, exergaming is a potentially major strategy to help improve physical activity levels and reduce obesity among Americans.

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## List of Abbreviations

| | |
|---|---|
| **EE** | Energy Expenditure |
| **ACSM** | American College of Sports Medicine |
| **MET** | metabolic equivalent |
| **DDR** | Dance Dance Revolution |

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**Table 1**

A summary of exergaming studies: stratified by game type

| ***Interactive aerobic fitness games*** | | | | | |
|---|---|---|---|---|---|
| **Reference** | **Study Design** | **Population** | **Exergaming Activity** | **Activity Duration** | **Results** |
| Mellecker and McManis et al., 2008 | Acute effect study; lab-based | n=18 children (11 males, 7 females) Ages 6 to 12 years; Caucasian | XaviX bowling and XaviX J-Mat | 25-minute gaming protocol consisting of 5 minute seated baseline, 5 minute seated computer bowling, 5 minute XaviX bowling, 5 minute seated rest, and 5 minute XaviX J-Mat | Energy expenditure was significantly higher for the two active videogames ($p<0.001$ for both) when compared with rest and seated videogaming. |
| Miyachi et al., 2010 | Acute effect study ; lab-based | n=12 adults (7 men, 5 women) Ages 25–44 years; Japanese | Wii Fit Sports (5 activities: golf, bowling, balance, tennis, baseball, and boxing) and Wii Fit Plus (63 activities classified as yoga, resistance, balance, and aerobic exercises) | 8 minutes on each activity | 46 activities were classified as light intensity and 22 activities were classified as moderate. |
| Graves et al., 2008 | Acute Effect Study ;lab-based | n=13 children (6 girls, 7 boys); Ages 11–17 years; Caucasian | Wii Sports Bowling, Boxing, and Tennis vs. inactive XBOX 360 | 15 minutes each game | Energy expenditure and HR were significantly greater in all active video games compared to rest and sedentary gaming ($p<0.001$). |
| Graves et al., 2007 | Acute Effect study ; lab-based | n=11 children (6 girls, 5 boys); Ages 13 to 15 years; Caucasian | Wii Sports Bowling, Boxing, and Tennis | 15 minutes each game | All active videogames significantly increased energy expenditure ($p<0.001$) above resting energy expenditure |
| Worley et al. 2011 | Acute Effect Study; lab-based | n=8 healthy young women | Wii Fit Hula and Wi Fit Steps | 10 minutes each at different intensity levels | Intermediate level of active videogames produced energy expenditure equivalent to moderate intensity exercise |
| Lanningham-Foster et al (2009) | Acute Effect Study; lab-based | n=22 children and adults | Wii Boxing | 10 minutes | Energy expenditure was significantly higher ($p<0.03$) when compared to resting and sedentary conditions |
| Leatherdale et al, 2010 | Acute Effect Study; lab-based | n=51 students | Wii Sports Tennis | 30 minutes | Energy expenditure was significantly higher($p<0.01$) playing active videogames compared to sedentary games |
| Mitre et al 2011 | Acute Effect Study; lab-based | Lean and obese children | Wii games | 15 minutes | Active videogames increased energy expenditure by 50% above resting |
| White et al 2011 | Acute Effect Study;lab-based | 26 boys | Wii Fit and Wii Sports | 8 minutes each game | Active videogames significantly increased energy expenditure ($p<0.001$) above resting levels |
| Graves et al 2010 | Acute effect study; lab-based | n=42 adolescents, young adults and older adults | Wii Fit | 10 minutes | Energy Expenditure was increased ($p<0.001$) with active videogames when compared to sedentary games. |

***Interactive aerobic fitness games***

| Reference | Study Design | Population | Exergaming Activity | Activity Duration | Results |
|---|---|---|---|---|---|
| Guderian et al 2010 | Acute effect study; lab-based | n=20 men and women | Wii Fit | 20 minutes | Energy expenditure was found to be equivalent to moderate intensity physical activity |

***Motion capture technology game***

| Reference | Study Design | Population | Exergaming Activity | Activity Duration | Outcome Measure | Results |
|---|---|---|---|---|---|---|
| Ni et al., 2008 | Randomized Controlled Trial; home-based | n=20 children (8 females, 12 males) Ages 12±1.5 years Cases=10 Controls=10; Caucasian | Sony EyeToy gaming package | 12-week intervention; substitute inactive videogame use with EyeToy active games | Activity counts (as measured by accelerometer) | Physical activity (counts per minute) was higher in the active video game intervention group when compared to the control group (mean difference at 12 week = 48 counts/min [95% C.I. −153, 187], p=0.6 |

***Dance simulation games***

| Reference | Study Design | Population | Exergaming Activity | Activity Duration | Outcome Measure | Results |
|---|---|---|---|---|---|---|
| Fawkner et al., 2009 | Short Term Intervention; lab-based | n=20 adolescent girls; Ages 14.0±0.3 yrs; Caucasian | ZigZag Xer-Dance (dance mat simulation game) | 30 minutes with 10 minutes at each of three difficulty levels | Energy expenditure | Significant (p<0.01) increases in all variables (apart from RER) between rest and each of the three levels of difficulty, and between levels 1 and 3 and 2 and 3 |
| Tan et al., 2002 | Short-Term Intervention; lab-based | n=40 subjects (21 males, 19 females) Ages 17.5±0.7 years; Caucasian | Dance Dance Revolution 3rd Mix | Six consecutive songs (approximately 10 minutes in total) | | During exergaming, participants had mean values were found to be comparable to that of medium-intensity aerobic dance |
| Unnithan et al., 2006 | Short-Term Intervention;lab-based | n=10 overweight and n=12 non-overweight children and adolescents (16 boys, 6 girls); Caucasian | Dance Dance Revolution | 12 minutes | Energy expenditure | Both groups met the ACSM recommendations for moderate intensity physical activity |
| Sell et al., 2008 | Short-Term Intervention; lab-based | n=19 male college students (12 inexperienced DDR players and 7 inexperienced DDR players); Ages 21.8±3.5 years; Caucasian | Dance Dance Revolution | 30 minutes of continuous game play | Energy expenditure | Compared with inexperienced players, experienced players exhibited significantly higher total energy expenditure (p<0.05). |
| Stroud et al 2010 | Acute Effect Study; lab-based | n=19 adults | Dance Dance Revolution | 10 minutes each 3 different intensity levels | Energy expenditure | Energy expenditure during high intensity games were significantly related to aerobic fitness |

***Interactive cycling game***

| Reference | Study Design | Population | Exergaming Activity | Activity Duration | Outcome Measure | Results |
|---|---|---|---|---|---|---|
| Haddock et al., 2009 | Acute effect study; lab-based | n=20 overweight children (13 boys, 7 girls); Ages 7 to 14; Caucasian | GameBike ergometer vs. standard bike ergometer | 20 minutes each bike | Energy expenditure | Increase in energy expenditure was significantly higher ($p<0.01$) using the GameBike |

***Isometric resistance games***

| Reference | Study Design | Population | Exergaming Activity | Activity Duration | Outcome Measure | Results |
|---|---|---|---|---|---|---|
| Bonetti et al., 2009 | Acute effect study; Lab-based | n=30 college males Ages 18–30 years Cases=16 Controls=16; Caucasian | Exerstation resistance game controller vs conventional handheld XBOX | 30 minutes | Heart rate, oxygen consumption, RPE, energy expenditure | The experimental group exhibited significantly higher values for oxygen consumption and energy expenditure when compared to controls. |

***Exergaming comparisons***

| Reference | Study Design | Population | Exergaming Activity | Activity Duration | Outcome Measure | Results |
|---|---|---|---|---|---|---|
| Maddison et al., 2007 | Acute effect study; lab-based | n=21children (11 males, 10 females) Ages 12.4±1.1 years; Caucasian | EyeToy's knockout (boxing); homerun (baseball); groove (dancing upperbody); antigrav (hover-board); and PlayStation 2 Dance UK (dance mat simulation game) | Participants were measured for a minimum of 5 minutes to a maximum of 8 minutes during each active videogame | Energy expenditure and activity levels | Energy expenditure was significantly ($p<0.001$) greater with the active video games when compared with resting and non-active videogame conditions. |
| Graf et al., 2009 | Acute effect study; lab-based | n=23 healthy children (14 boys, 9 girls); Ages 10 to 13 years; Caucasian | Dance Dance Revolution(DDR); and Wii Sports Boxing and Bowling | DDR-15 minutes at beginner level and 15 minutes at basic level; Wii Boxing and Bowling-15 minutes each | Energy Expenditure | All active videogames resulted in significant elevations in energy expenditure ($p<0.05$) and increased 2- to 3-fold above resting values |
| Seigel et al., 2009 | Acute effect study; lab-based | n=13 college students (6 male, 7 female) Ages 26.6±5.7 years; Caucasian | 3-Kick, Jackie Chan Studio Fitness Power Boxing, and GameBike (Disney's Cars Piston Cup Race) | 30 minutes to perform any one of the three games (participants' choice | Energy Expenditure, heart rate; ability to meet ACSM recommendations | Energy expenditure and heart rate increased significantly above baseline values ($p<0.01$). |
| Lanningham-Foster et al., 2006 | Acute effect study; lab-based | n=25 healthy children (12 boys, 13 girls) Ages 9.7±1.6 years; 22 Caucasian; 2 Asian; 1 African American (not of Hispanic origin) | EyeToy (NickToon's Movin); and Dance Dance Revolution | 15 minutes each game | Energy expenditure | Significantly greater increases ($p<0.00001$) in energy expenditure were found for both active videogames when compared with sitting, watching television and seat-based videogaming |
| Bailey et al 2011 | Acute effect study; lab-based | n=39 boys and girls | Six types of active videogames; Dance Dance Revolution, Lightspace, Nintendo Wii, CybexTrazer, Sportwall, and Xavix | 15 minutes | Energy expenditure | All active videogames increased energy expenditure levels above rest($p=\leq0.05$) |

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| ***Exergaming comparisons*** | | | | | | |
|---|---|---|---|---|---|---|
| **Reference** | **Study Design** | **Population** | **Exergaming Activity** | **Activity Duration** | **Outcome Measure** | **Results** |
| Lyons et al 2011 | Acute effect study | n=100 young adults | Shooter, Band Simulation, Dance mat controller and fitness | 13 minutes each game | Energy Expenditure | Fitness and dance simulation games increased energy expenditure above rest by 322% and 298% respectively |