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ORIGINAL ARTICLE

Comparing Enjoyment and Perceived Exertion Between Equivalent Bouts of Physically Interactive Video Gaming and Treadmill Walking

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Abstract

BACKGROUND: Physical activity and positive health behaviors are not usually associated with playing video games. "Exergaming", which requires whole body movement to interact with the video game, has the potential to change this negative relationship if it can be shown that people find it enjoyable. PURPOSE: The purpose of this investigation was to compare rating of enjoyment and rate of perceived exertion (RPE) between exergaming with Dance Dance Revolution (DDR) and traditional treadmill walking, done at similar VO_2. METHODS: Eighteen, 18-28 year old DDR novices participated in the investigation. All participants had two DDR practice sessions prior to testing. A Likert scale for enjoyment and the OMNI RPE scale were used to determine differences between isocaloric bouts of exergaming and treadmill walking sessions. Differences were statistically evaluated using paired t-tests. RESULTS: Participants reported a significantly higher ($p<0.05$) rating of enjoyment following the exergaming session while there was no statistical difference in RPE between exergaming and treadmill walking (at matched workloads). CONCLUSION: Due to exergaming's rising popularity, increasing accessibility and favorable enjoyment rating, exergaming is a valuable alternative to traditional modes of exercise for increasing regular participation in physical activity. **Health & Fitness Journal of Canada 2010;3(1):12-18.**

Keywords: Obesity, Physical Activity, Lifestyle related disease, Rate of Perceived Exertion, Interactive video games, Enjoyment

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Introduction

Obesity has become a major health issue for American adults. In fact, the rise in obesity rates has often been referred to as an epidemic. According to the Centers for Disease Control (Flegal, et al., 2010), 68% of American adults over 20 years old are either overweight or obese. Obesity has been shown to have a causal relationship to lifestyle related conditions such as Type II diabetes, cardiovascular disease, gallbladder disease and sleep apnea (Conroy et al., 2005). There is considerable agreement that inactivity is one of the major contributors to obesity and lifestyle-related diseases (Warburton et al. 2006). It is also widely accepted that physical activity is beneficial to overall health and wellness. Despite these facts, most adults do not participate in regular exercise. Data from the National Health Interview Survey show that nearly 40% of adults reported no leisure time physical activity (USDHHS, 2001). Therefore, researchers and practitioners need to seek new and innovative strategies to increase the likelihood that individuals will engage in physical activity. The solution may be found in a non-traditional form of exercise, known as exergaming.

Exergaming consists of video games that require whole body movement to play and can result in higher metabolic demands than traditional cycling exercise at matched submaximal workloads/ intensities (Warburton et al., 2009). A recent review of the literature (Mark et al., 2008) suggests that interactive video gaming can provide increased oxygen consumption (VO_2) and energy expenditure compared to traditional video gaming. Exercise with this novel video gaming equipment may meet (Tan et al., 2002) and even exceed (Warburton et al 2007; Warburton et al., 2009) ACSM recommendations for intensity. Moreover, one of the key benefits of exergaming is that individuals may gravitate towards these modes of nontraditional exercise, as they may be more entertaining and enjoyable than traditional modes of exercise (Rhodes et al., 2009).

Sell et al. (2008) observed a significantly higher level of enjoyment compared to treadmill walking among college students. Additionally, Warburton et al. (2007) found that participants attended more exercise sessions with exergaming compared to the control group, indicating greater exercise adherence. Rhodes et al. (2009) conclude that exercise on an interactive video bike may lead to greater exercise adherence due to the fact that the activity produces higher affective attitudes.

The possibility of a lower rate of perceived exertion may be another benefit to exergaming. Exergaming has been shown to elicit similar ratings of perceived exertion (RPE) despite higher metabolic requirements (at matched workloads) using exergaming (Warburton et al., 2009). Moreover, RPE can be affected by task aversions such as listening to music, goal setting, or engaging in competition (Robertson, 2004).

One popular example of exergaming is Konami's® Dance Dance Revolution (DDR). The DDR system integrates all of the task aversion techniques outlined by Robertson (2004). Participants listen to music while playing, have the opportunity to advance to increasingly difficult game stages, and can compete against multiple players. Few studies have examined these variables using this popular piece of equipment. However, due to the large appeal of video games and the positive consequences of engaging in this nontraditional form of exercise (Warburton et al., 2007), the study of such pieces of equipment is warranted. It is anticipated that research on exergaming may also contribute to innovative and effective design of physical activity interventions.

The primary purpose of this study was to compare level of enjoyment and the rating of perceived exertion (RPE) between exergaming, with Dance Dance Revolution for 30 minutes, and 30-minutes of treadmill exercise, done at similar VO_2. We hypothesized: 1) that participants will rate exergaming as more enjoyable than treadmill walking; and 2) exergaming will elicit a lower average RPE when compared to treadmill exercise at equivalent VO_2.

Methods

Participants

Eighteen (10 males, 8 females), low-risk (ACSM, 2006) volunteers participated in this investigation. Recruitment occurred among undergraduate students at a large Central California University. The mean age (± SD) of the participants was 22.2 ± 2.0 yr. Participants had a mean height of 171 ± 12 cm, and a mean weight of 74.5 ± 12.7 kg. The participants were

delimited to those whom had little or no experience with the game DDR and were required to participate in two 30 min familiarization sessions. The nature and risks associated with the study were explained to the subjects prior to their participation and all signed an informed consent approved by the university's Committee for the Protection of Human Subjects.

Exergaming Equipment

A Sony Playstation® 2 (Tokyo, Japan) video game system connected to a Dance Dance Revolution ion® dance mat (DDRgame, Rosemead, CA) was used during the exergaming protocol. DDRMax2 was the Playstation® 2 video game played and it was viewed on a 27" television. Dance Dance Revolution (DDR) is an interactive video game that requires the player to move their feet and touch directional arrows (↑↓←→) on the DDR ion dance mat when corresponding arrows are highlighted on the television screen. More points are acquired when the player maintains accuracy and timing when touching the arrows on the dance pad. The player is scored at the end of each session. All participants were tested using the same "beginner" level of play, 20 predetermined songs, and routines. The game was set on "non-stop" mode that allowed the 20 song routines to be played continuously.

Experimental Protocol

The experimental protocol included participation in a 30 minute DDR testing session, followed 2 days later by a second testing session of treadmill exercise (Landice® brand Pro Sports Trainer; Landice Inc., Randolph, NJ). The oxygen consumption (VO_2) was held constant for the two exercise bouts, to be able to properly compare RPE for exercise at the same intensity level. ACSM metabolic equations were used to determine a speed and grade that would elicit a VO_2 equivalent to that of DDR exercise. Grade and speed were adjusted, as needed every minute in an effort to replicate oxygen cost of the DDR session. There was no statistical difference in VO_2 between the two exercise bouts. A Parvo Medics True 2400 Metabolic Gas Analyzer (Sandy, Utah) was used to determine oxygen cost for both testing sessions. The VO_2 was measured at 30-second intervals. Gas calibration and flowmeter calibration was done prior to each test.

Evaluation of Enjoyment and RPE

A Likert enjoyment scale was presented to the participants at the end of both the DDR testing session and the treadmill exercise session. The participants were asked to identify how much they enjoyed doing each mode of exercise on a scale of 0-10. Zero represented that the exercise session was "not at all enjoyable" and 10 represented that the exercise session was "extremely enjoyable."

Similarly, an OMNI 10 category Rate of Perceived Exertion Scale (Robertson, 2004) was used to assess RPE for each participant. This scale was shown to the participant and standard verbal instructions were given following both the DDR testing session and the treadmill exercise session.

Statistical Analysis

Descriptive variables were reported (mean ± SD) for age, height, and weight. Paired t-tests were used to identify differences between group means for the following dependent variables: VO_2, level of enjoyment, and RPE. The level of significance was set a priori at $\alpha = .05$. As a result of using multiple paired t-tests,

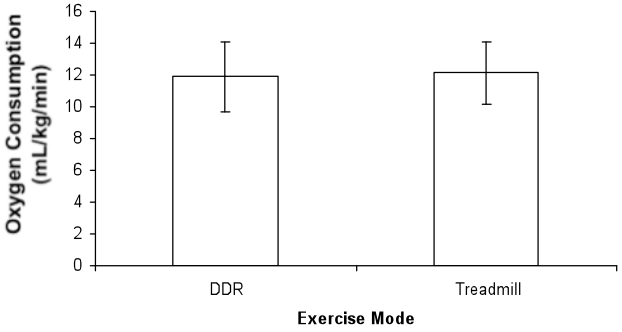
the alpha level was corrected using sequential Bonferroni correction procedures.

Results

Oxygen Consumption (VO_2)

The mean VO_2 during the DDR session was 11.88 ± 2.23 mL/kg/min. The mean VO_2 during the treadmill session was 12.14 ± 1.96 mL/kg/min (Figure 1). The results of a paired t-test indicated VO_2 was not significantly different between the two exercise modes. $t(17) = -2.02$, $p = 0.06$, $d = -0.97$, $r_{Y\lambda} = 0.44$. This result revealed that both the DDR and treadmill exercise were done at equivalent VO_2 levels.

Figure 1: Comparison of oxygen consumption between Dance Dance Revolution (DDR) and Treadmill exercise.



Enjoyment

The mean enjoyment rating for the DDR exercise mode was 6.83 ± 2.45. The mean enjoyment rating for the treadmill exercise session was 3.08 ± 2.15 (see Figure 2). The results of a paired t-test indicate that level of enjoyment was significantly higher (following the DDR exercise session. $t(17) = 5.98$, $p < 0.001$, $d = 2.90$, $r_{Y\lambda} = 0.82$.

Rate of Perceived Exertion

Mean RPE following the DDR session was 3.33 ± 1.45. Mean RPE following the treadmill session was 3.19 ± 1.47 (see Figure 3). The results of a paired t-test indicated that RPE was not significantly different between the two exercise modes. $t(17) = 0.411$, $p = 0.68$, $d = 0.20$, $r_{Y\lambda} = 0.10$.

Figure 2: Comparison of level of enjoyment between Dance Dance Revolution (DDR) and Treadmill exercise. * Indicates a significant difference, $p<0.05$.

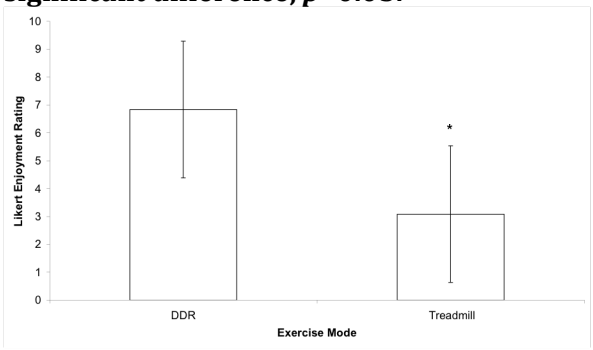
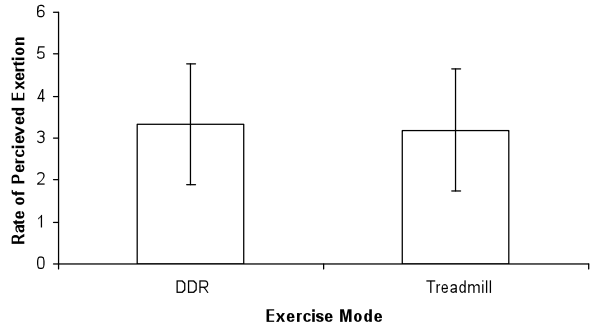


Figure 3: Comparison of rating of perceived exertion between Dance Dance Revolution (DDR) and Treadmill exercise.



Discussion

The first hypothesis stated that the participants would enjoy DDR more than traditional treadmill exercise. This hypothesis was supported and is consistent with the literature. Recent studies have demonstrated that participants who engaged in interactive video gaming achieved higher levels of enjoyment compared to those who exercised in more traditional ways (Warburton et al., 2007; Sell et al., 2008). This result is important as motivational

factors such as enjoyment, goal setting, competition and exercising with friends play a role in long-term exercise compliance (Johnson, 2007), with enjoyment being one of the most critical factors to exercise adherence (reference needed here). In support of this finding, Howe (2005) found that individuals were more likely to participate in exercise to have fun rather than to lose weight or achieve improvements in their health. The present study demonstrates that DDR is significantly more enjoyable than treadmill walking, and when individuals enjoy an activity, such as exergaming, they are more likely to adhere to the activity (Warburton et al, 2007). Added benefits of DDR include motivational factors such as goal setting, competition and social interaction. Therefore, DDR seems to be an ideal form of exercise as it is enjoyable and has the potential to motivate people, which in turn can result in a higher level of commitment to their exercise program. Further, when individuals enjoy exercise, this can help them achieve the recommended amount of exercise, which the ACSM suggests is 30 minutes or more of moderate-intensity physical activity on most, and preferably all, days of the week (2006). Therefore, exercise, such as exergaming, done according to ACSM guidelines can help fight the problems of obesity and associated conditions.

To date, few studies have evaluated the difference in RPE between exergaming and a traditional form of exercise, such as treadmill walking, done at similar intensity. The findings of this study suggest that there is no difference in RPE between traditional treadmill exercise and DDR exercise done at an equivalent VO_2. This is a similar finding to the work of Warburton et al. 2009 who examined RPE during matched workloads on an electronically braked cycle ergometer.

RPE may be influenced by factors like emotion, mood, and other perceptual processes such as pain tolerance (Robertson, 2004). RPE is also influenced by situations that include task aversions. For instance, the presence of music or participating in an activity with a friend may affect RPE (Robertson, 2004). Because of these factors, it was hypothesized that RPE would be lower following DDR exercise. This hypothesis was rejected despite the fact that DDR includes task aversions including music.

Another factor that may have contributed to this rejection of the second hypothesis is that the participants may have taken into account the difficulty of the game and the complexity of the dance steps when rating their exertion. Research indicates that increases in RPE are linear with increases in exercise intensity, heart rate, and oxygen consumption (Utter et al., 2004). However, when comparing a traditional activity, like walking, to a more difficult task while at similar intensities, rate of perceived exertion may be affected by the more complex task (Grego et al., 2004). Therefore, participants may focus their attention on accomplishing the more complex activity, rather than focus on internal sensations and fatigue that will affect perceived exertion, resulting in inconsistent ratings with the intensity of the exercise (Grego et al., 2004). For example, a recent study demonstrated that participants were more likely to rate perceived exertion higher for the complex task of race walking rather than traditional walking, despite intensity remaining similar (Grego et al., 2004). In the present study, RPE may have been affected by the complexity of the dance game.

There are some limitations that should be noted in regards to this study. Enjoyment may have been affected by the treadmill exercise, as many people may not find this enjoyable, compared to walking outdoors. Due to equipment restrictions, and the need to collect oxygen consumption, this must be also listed as a limitation. The participants were recruited and were volunteers, therefore, a random sample was not utilized. Also, the participants were all novices to interactive video gaming. Therefore, due to the limited age range and novice level, these results should be generalized with caution. Also, all participants were unfamiliar with the RPE scale utilized prior to this study. Despite standard instructions, occasionally, clients utilizing an RPE scale do not understand the concept of perceived exertion and therefore cannot properly use a category RPE scale (Robertson, 2004). An OMNI RPE scale (Robertson, 2004) was used in this study. Category scales like the OMNI RPE scale are recommended for use with nearly any kind of exercise setting (Robertson, 2004). Several studies have evaluated the OMNI RPE scale and concluded that the validity and reliability of the OMNI scale are adequate and may be used to accurately estimate RPE for use with both adults and adolescents (Robertson, 2004). However, ACSM (2006) advises professionals to use caution with RPE scales due to the large individual variability.

Summary and Conclusions

The results of this study are relevant due to the fact that nearly 75% of households have a member who plays video games (Entertainment Software Association, 2006). Many physical activity interventions have attempted to separate people from the television and computer screen in an effort to increase physical activity time. However, people highly value these games and are reluctant to stop playing them (Lanningham-Foster et al., 2006).

An increase in these types of games may ultimately lead to an increase in physical activity. Several studies have also concluded that interactive video games can lead to greater adherence and improvements in health-related physical fitness (Warburton et al., 2007). Exercise adherence is one of the most important contributing factors to increased fitness, and therefore, can lead to decreases in obesity and lifestyle related diseases.

The popularity of new and emerging interactive video game systems clearly shows that the video game industry recognizes the demand for video games that incorporate physical activity. Therefore, due to exergaming's rising popularity, increasing accessibility and favourable enjoyment rating, exergaming is a valuable alternative to traditional modes of exercise. Exergaming should be considered when designing physical activity programs to improve health.

Qualifications

The authors' qualifications are as follows: Lisa Janzen Leininger, M.A., Ed.D (in progress), Michael Coles, Ph.D., Jenelle N. Gilbert, Ph.D.

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