EFFECTIVENESS OF A TECHNOLOGY BASED PHYSICAL ACTIVITY PROGRAM IN ADULTS WITH INTELLECTUAL DISABILITIES

by

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ABSTRACT

Physical activity of individuals with intellectual disabilities (ID) is lower compared to their peers without ID. This decreased physical activity places individuals with ID at risk to be overweight or obese, have low cardiorespiratory fitness, and decreased muscular strength. The purpose of this study was to determine if a Nintendo Wii based exercise program is as effective as traditional exercise program for individuals with ID. Participants included were 14 individuals with ID between the ages of 18-25 years old. Individuals were randomly placed into two groups: Nintendo Wii Fit and Traditional exercise. After randomization participants completed a pre-test consisting of one-repetition maximum leg press and chest press along with a 20m PACER test. The training occurred 60 minutes, once per week for eight weeks. At post-test independent samples t-test showed a significant time effect for Leg Press ($p=0.003$). Comparing post-test values from the Wii group to the traditional group, there was no significant difference for the PACER ($p=0.101$) or Chest Press ($p=0.077$). Participants in the Wii group showed greater improvement in the Leg Press ($p=0.009$). The Wii was as effective as traditional exercise for adults with intellectual disabilities.

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Introduction

According to the American Association on Intellectual and Developmental Disabilities, an intellectual disability is, "a disability characterized by significant limitations both in intellectual functioning (reasoning, learning, problem solving) and in adaptive behavior, which covers a range of everyday social and practical skills". Additionally, the disability originates before the age of 18 (Alfaro 2013).

The physical activity of individuals with intellectual disabilities (IDD) is considerably lower than among their peers without intellectual disabilities (Einarasson 2014). In a representative population-based sample of older adults, approximately 6% of adults with IDD get the recommended physical activity (Hilgenkamp et al., 2012). The low level of fitness found in persons with IDD is attributed to their passive lifestyle, low motivation, as well as other psychological and physiological factors. Of all the factors examined, an inactive life style appears to be most detrimental to physical fitness in this population (Lotan 2010). Due to this lack of physical activity, individuals with IDD are more likely to be overweight or obese and have low cardiorespiratory fitness, putting them at a much greater risk for cardiovascular disease and all-cause mortality (Haney 2014; de Winter 2012; Oppewal 2013). Obese individuals with IDD are not only at a greater cardiovascular disease risk, but also secondary health conditions as compared to healthy weight individuals with IDD (Rimmer 2010). To decrease these risks for disease, it is imperative that individuals with IDD exercise (Bartlo 2011).

The benefits of exercise are well researched and documented; however, individuals with ID do not get enough. Some of the barriers people with ID face

include lack of choice and/or understanding (Hawkins & Look, 2006), lack of motivation to participate (Temple & Walkley, 2007), immobility and illness (Finlayson et al., 2009), a lack of staff training and support, individuals' mood (Hawkins & Look, 2006), risk assessment issues (Hawkins & Look, 2006), and also financial constraints (Hawkins & Look, 2006). Other issues individuals with ID face are: lack of transportation, the need for someone to supervise them working out, and/or fear of being made fun of for their disabilities. Aharoni (2005) indicates that social attitude of equality and acceptance plays a major role in individuals with ID's motivation. Therefore, fear and/or lack of acceptance lead to a lack of regular participation in physical activity, especially at a gym.

Bartlo (2011) indicates that research completed for the development of physical activity programs adaptable to the needs of individuals with ID needs to be activated. One adaptable physical activity program put into practice is a technology based exercise program, also known as an exergame. Exergames, such as the Nintendo Wii Fit, have been created to bring the gym to people's homes.

Purpose of Study

The current study aims to determine if a technology based program is as effective as traditional exercise program for individuals with ID. Specifically, this study will attempt to determine whether strength and aerobic fitness improves when performing the exercises on the Nintendo Wii Fit as much as it would improve performing the same exercises in a gym, for individuals with ID.

The purpose of this study is to evaluate the effectiveness of the Nintendo Wii Fit on individuals with ID. If the technology proves effective, it will give

individuals with ID an opportunity to get the exercise they need without the problems associated with going to the gym.

Hypotheses

The Wii Fit does not have any resistance aspect in its program, therefore, it is hypothesized that there will be a greater increase in strength in the traditional fitness group. Also, there will be little to no difference in aerobic fitness between groups.

Literature Review

Chung, Harvey, and Hassett (2014) examined how much, and in what way, the Nintendo Wii is used when prescribed as part of a home physiotherapy program for people with intellectual disabilities. They concluded that, on their own, Wii usage dropped off rapidly when individuals were in charge of their usage. However, if the person using the Wii is given encouragement and their usage is monitored, it could still be an effective physical activity program.

General Effectiveness

In regards to effectiveness, a large concern is the amount of time spent exercising and if it reaches national standards. Perron (2011) studied if typically developing children using the Wii Fit or EA Sports Active achieved CDC prescribed physical fitness guidelines. They used heart rate and perceived exertion to determine that both games achieved moderate intensity exercise and met the guidelines for an appropriate amount of exercise. Researchers also found that Wii Fit Boxing results in a greater heart rate compared to treadmill walking,

and children enjoyed Wii Fit Boxing more than walking on the treadmill (Perron, 2011). One aspect this study did not include was a measure of physical fitness. The current study hopes to further study effectiveness by including measures of physical fitness. Peng et al. (2013) conducted a systematic review of all the research regarding exercise interventions using active video games (AVGs) to increase physical activity. They found that all AVGs were better liked than traditional exercises, and adults enjoyed the lower intensity AVGs such as the Wii Fit. The fact that people enjoy the AVGs better than traditional exercise is important for getting people to use them as a form of exercise if they are not willing/able to perform traditional exercise. Another finding was that all AVGs studied achieved light-moderate intensity exercise from their users, while it was found that the AVGs are adequate forms of exercise according to Peng et al. they do not increase physical activity levels.

Health Outcomes of Exergame Usage

Investigators found that people enjoyed using exergames such as the Nintendo Wii Fit, which suggests that exergames might help improve exercise compliance in marginally fit people (Sator 2010). Additionally, while using exergames it was found that participants saw a decrease in weight, BMI, and resting heart rate (Sator 2010). In regards to cardiovascular fitness, Naugle et al, (2014) found that Nintendo Wii Fit boxing has the greatest potential for use as a cardiovascular fitness tool.

Comparison of Traditional Fitness to Exergames

Bumgarner and Senchina (2013) compared EA Sports Active to traditional fitness and found they gym was better for everything physiologically except squats. Additionally, heart rate in the exergame was usually lower than the gym, but it varied by exercise. The gym was better for performance except basketball was performed more accurately on the EA Sports Active. Due to these results the investigators suggest exergames are best set for PT or rehab settings. Douris et al. (2012) compared to Nintendo Wii Fit to traditional fitness and found that the Free Run on the Wii Fit did better elevating heart rate and rate of perceived exertion than running on a treadmill. It was also found that the free run might act as an alternative to traditional moderate-intensity aerobic exercise in fulfilling the ACSM requirements for physical activity.

Populations with Disease or Disabilities

In individuals with cystic fibrosis O'Donovan et al. (2014) found that Wii boxing and free jogging produced light to moderate activity, and the activities are useful forms of physical activity. Dickinson and Place (2014) studied a computer based activity program for reducing BMI in children with autism. The investigators found significant improvements in every category on the Eurofit test, especially cardiopulmonary fitness. This discovery is wonderful because the active video games offer children with autism a visual and nonjudgmental opportunity to take part in games that make no social interaction demands. In children with cerebral palsy Tarakci et al. (2013) found that active video games improved static balance in a safe, enjoyable, suitable, and effective way. Finally,

Lotan, Yalon-Chamovitz, & Weiss, (2010) looked at virtual reality as a means to improve fitness in individuals with severe IDD. The investigators found a significant reduction in heart rate, but the results were not strong enough to claim the program improved physical fitness of individuals with IDD. They did find that the program was awesome for motivation to get the children exercising which is beneficial.

Methods

Participants

Participants were 14 individuals with ID between the ages of 16-25 years old. The participants were recruited through flyers posted around Mental Health, Mental Retardation of Tarrant County as well as ARC of Tarrant County, and by word of mouth. They were ambulatory, able to follow instructions, and able to familiarize with all the activities. Once recruited, the participants completed a consent form and were able to drop out of the study at anytime without penalty. The participants were randomly placed into 2 groups: Wii Fit, and Traditional exercise. The result after randomization of the groups were not statistically significant, PACER ($p = 0.32$) chest press ($p=0.56$), leg press ($p=0.83$) at baseline.

Apparatus

The Nintendo Wii Fit was used to perform the strength and aerobic exercises in the Wii Fit group. The use of the Nintendo Wii required two TVs to project the games. The machines in the weight room of the TCU Recreation Center were utilized for the traditional exercise group. The leg press machine

and the chest press machine were used to measure gains in strength for the pre and posttests. For 20m PACER test, used for pre and post testing, a stopwatch and two cones were utilized. Vitale, Jankowski, and Sullivan (1997) concluded that the PACER test is a reliable field test to assess aerobic capacity.

Group	Enrollment	Pre	Intervention	Post
Wii	Consent, Assent, familiarization, and randomization	Leg Press, Chest Press, and 20m PACER	**Aerobic:** Wii Boxing, Wii Running Intensity: 5 minutes per exercise **Strength:** • Wii Tricep Extension • Wii lunge • Wii push-up • Wii squat Intensity: 5 minutes per exercise	Leg Press, Chest Press, and 20m PACER
Traditional			**Aerobic:** Boxing, Running Intensity: 5 minutes per exercise **Strength:** • Triceps Extension • Lunge • Push-up • Squat Intensity: 3 sets of 12 per exercise	
Duration	30 – 45 min	30 – 45 min	30 - 45 min / session, 3 days / week	30 – 45 min
	Week 1	Week 2	Week 3-11	Week 12

Procedure

Participants reported to the TCU Recreation Center for the first time for a pre test where they performed the leg press, chest press, and 20m PACER. Data was collected and they were free to go. After the pre-test, participants selected reported to the TCU Recreation Center 3 times a week for 60 minutes sessions for 8 weeks. At the end of the 8 weeks all participants reported to the TCU Recreation Center for post-testing. The post testing consisted of the same tests as the pre-test. Data was collected and the participants were free to go. All participants were asked not to perform any exercise outside of what they performed with the study. They started in the multipurpose room two with a warm up stretching period of 10 minutes, stretching all the major muscle groups, which was led by a co-investigator. They then split into the two groups, one performing traditional exercise, and one using the Wii Fit. The Wii Fit group went over to where two TVs were set up with the Wii Fit console. Fou participants from that group performed the triceps extension, lunge, push-up, and squat using the Wii Fit for 5 minutes per exercise. They then performed the boxing and running exercises using the Wii Fit for 10 minutes per exercise. The traditional fitness group was led by a co investigator in the same strength exercises using machines in the weight room. Then a co-investigator monitored them while they performed the running exercise on the track for 10 minutes, and the boxing exercise with the hanging bag for 10 minutes. After each group was finished, they met back in the multipurpose room two for a cool down stretch, stretching all the major muscle groups for 10 minutes lead b a co-investigator.

Design & Analysis

The present study was a mixed study of between groups (2 x 2) design measuring strength and aerobic fitness (groups x pre-post study). The dependent measures of strength and aerobic fitness were measured using the leg press and chest press for strength, and the 20m PACER for aerobic fitness. One multifactorial analysis of variance (ANOVA) was used on the dependent measures of strength and a separate multifactorial ANOVA was used on the dependent measure of aerobic fitness. A significant ANOVA was followed by a Tukey Post-Hoc to determine mean scores responsible for significance. The alpha level was set at 0.05 for all analyses to avoid rejecting a true finding.

Results

Group statistics between the Wii group and the Traditional group for all 14 were analyzed, expressing mean and standard deviations for the raw score. The statistics were divided into pre test and post test. There were no significant differences between groups at baseline (PACER p= 0.321) (Chest Press p=0.564) (Leg Press p=0.833). There were also no significant differences comparing Wii to Traditional groups at post tests (PACER p=0.217) (Chest Press p=0.693) (Leg Press p=0.590).

Statistics were further broken down based on groups. Within the Wii group there was no significance pre to post (p=0.282) and a medium time effect (d=0.077) for the Chest Press. Within the Traditional group there was no significance pre to post (p=0.156) and a small effect size (d=0.16) on Chest Press. Within the Wii group there was no significance pre to post (p=0.28) and a

very large time effect (d=1.36) for the Leg Press. Within the Traditional group there was no significance pre to post (p=0.08) and a small effect size (d=0.25) on Leg Press. Looking at the PACER, within the Wii group there was no significance pre to post (p=0.298) and a small effect size of (d=0.20). In the Traditional group there was no statistical significance pre to post (p=203) and a small effect size (d=0.32). Comparing the Wii to Traditional groups on the PACER there was a large effect size (d=0.84).

Our sample matched the population in regards to BMI classification. 72.73% of the group was obese (BMI > 30), 18.18% was overweight (BMI between 25-29.9), and 9.09% were normal weight (18.5-24.9).

Discussion

A primary focus of this study was to determine if computer based exercise interventions would perform as well as traditional fitness. Results from this study indicate that the hypothesis that there would be little to no difference in aerobic fitness between groups is accepted. There were no significant differences in aerobic fitness (PACER p=0.101) between pre and post testing between Wii and Traditional fitness.

Figure 5 shows a higher amount of sedentary activity for the Wii group with an increased moderate activity for the Traditional group. This initially seems counterintuitive to the results; however, this difference on the graph could be due to the difference in training styles. For the Wii group there were three or four people using one Wii console, while in the Traditional group there were two people sharing one machine. Due to this difference in timing, there was

more time in between activity for the Wii group compared to the Traditional group, which would cause the Wii group to appear more sedentary on a graph. There was also a large effect (d=0.84) comparing Wii to Traditional on the PACER. This can be explained because of the difference in training style. The Wii group performed stationary aerobic activity, running in place and boxing with the Wii remotes in place, while the Traditional group aerobic activity was more dynamic with running on a track and boxing with gloves on a bag. Due to this difference it was also reflected in Figure 5 that the Traditional group experienced more moderate-vigorous activity.

In regards to strength, group performance was similar on the Chest Press. The weights used for the Traditional group were dumbbells light enough to mimic the weight of the Wii Remotes, which could explain the similarities between group performances on the Chest Press. The hypothesis that there would be a greater increase in strength in the traditional fitness group was rejected because group performance was not statistically different between groups. Bodyweight exercises were utilized for both groups during strength training, which could explain the lack of differences.

One hope of this study was to build upon Perron (2011) and add the measurement of physical fitness. Perron (2011) looked at the general effectiveness of active video games and found people got the physical activity they needed, which the current study's findings support. However, there were no statistically significant improvements in physical fitness after utilizing the Wii Fit, which supports the work of Peng et al. (2013) in their systematic review of active video games.

While there was no significant improvement in physical fitness, Peng et al. (2013) and Sator (2011) found that people enjoy using the exergames more than traditional fitness, a fact that was similarly noticed by the investigators in this study through interaction with the participants. Studies have also found that activities such as the Wii Boxing and Wii Free Run are comparable to traditional fitness as tools for performing appropriate amounts of physical activity. The current study utilized both of those activities on the Wii Fit and found similar results. There may not be an improvement in physical fitness, but there are health benefits such as a decrease in weight, BMI, and resting heart rate according to Sator (2010). For adults with intellectual disabilities, and other disabilities related to obesity, a decrease in weight and BMI are more important than improvements in physical fitness. The current study supports the idea that getting the right amount of physical activity, with increased enjoyment of performance and health benefits, is more important for this population than improvements in physical fitness.

Chung Harvey and Hassett (2014) found that Wii usage dropped off rapidly when individuals were in charge of their usage. However, this is where the support of a family or health care professional could play an important role. If the person using the Wii is given encouragement and their usage is monitored, it could still be an effective physical activity program. This program would be an excellent mode of physical activity within homes or in a rehabilitation or PT setting.

Implications

As demonstrated by Figure 1 obesity is a huge issue in this population. This study's results could help adults with intellectual disabilities combat this obesity through the use of the Nintendo Wii Fit. Based on the results of strength and aerobic performance it does not appear that one group is better than the other in this sample, indicating the Nintendo Wii could be a viable option for adults with intellectual disabilities to get the appropriate amount of exercise. During the 60 minutes investigators had with the participants, exercise approached about 30 of participants recommended 150 minutes per week (20%) of moderate exercise. Based on those calculations, if adults with intellectual disabilities utilized the Wii Fit five days a week they would get all their recommended activity from the safety of their home, effectively avoiding many barriers to exercise addressed earlier.

Future Directions

In the future, it would be best to compare other exergames effectiveness with this population as well as other populations with disabilities related to obesity. Additionally, future studies should test a larger sample size for a longer period of time to discover any long term effects. Finally, when testing other exergames investigators should ensure the directions are easy to understand and follow.

Figure 1: Body Composition

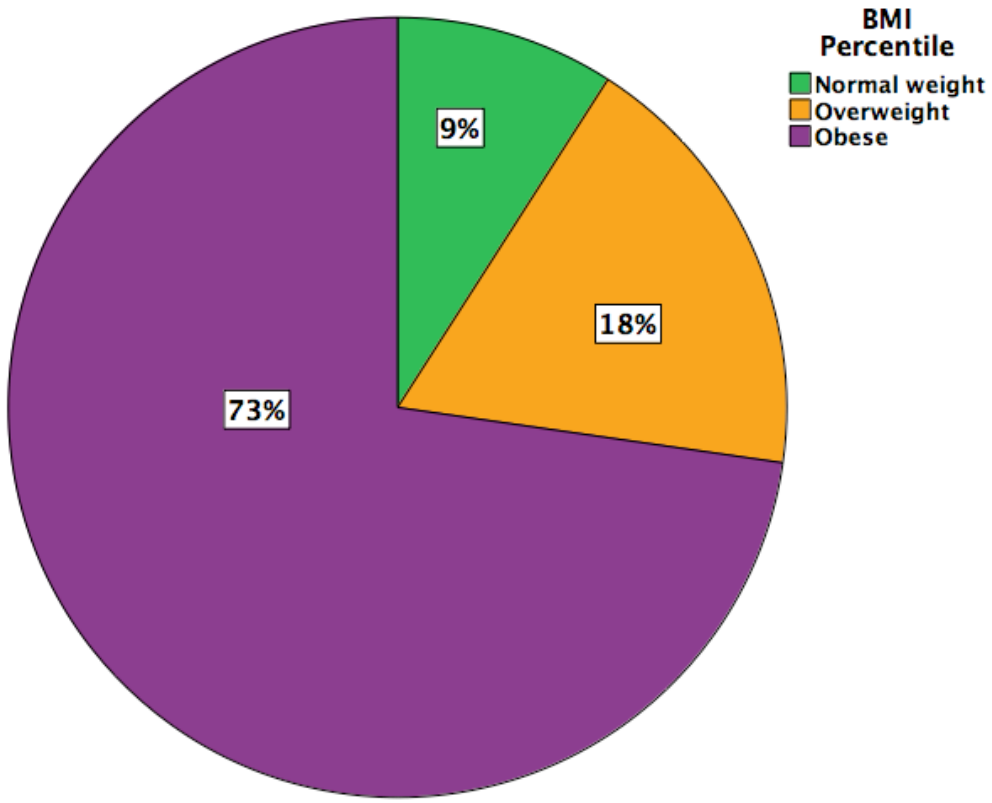


Figure 2: Leg Press Comparison

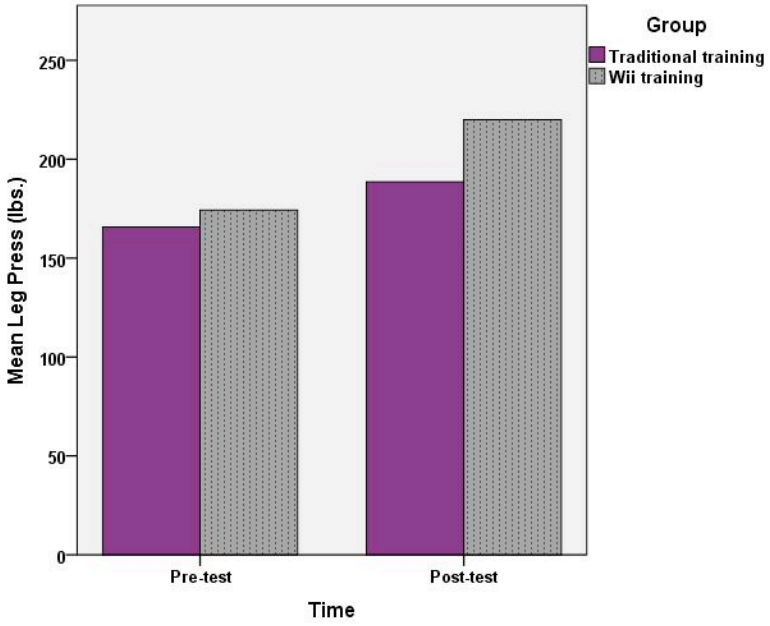


Figure 3: Chest Press Comparison

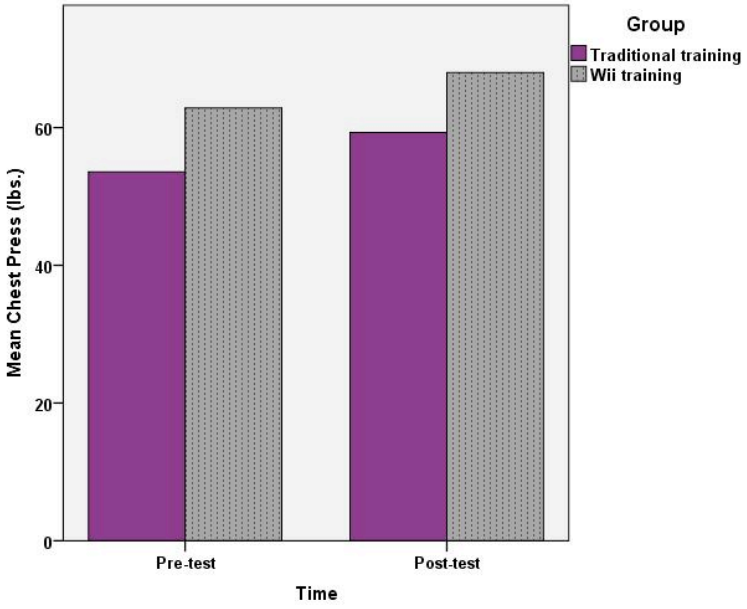


Figure 4: PACER Comparison

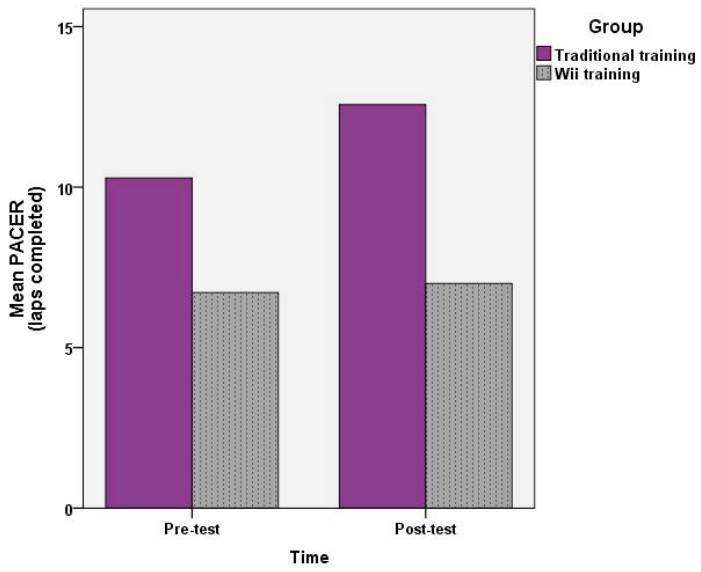
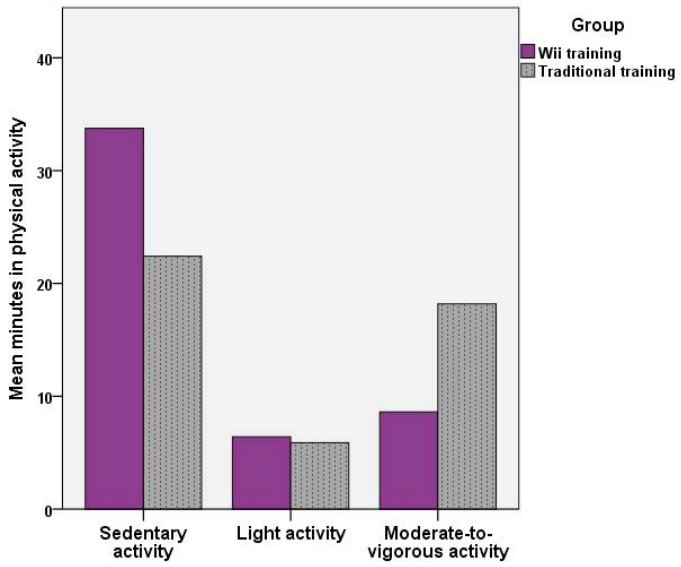


Figure 5: Physical Activity Levels



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