THE INFLUENCE OF A WII FIT PLUS EXERCISE PROTOCOL ON LOWER EXTREMITY STRENGTH AND BALANCE IN AN ADULT POPULATION

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Master of Science

Renee DeSalvo

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THE INFLUENCE OF A WII FIT PLUS EXERCISE PROTOCOL ON LOWER EXTREMITY STRENGTH AND BALANCE IN AN ADULT POPULATION

Renee DeSalvo

Thesis

Approved:  
Accepted:

Advisor  
Dr. Judith Juvancic-Heltzel

Dean of the College  
Dr. Mark Shermis

Committee Member  
Dr. Ronald Otterstetter

Dean of the Graduate School  
Dr. George Newkome

Committee Member  
Carrie Fister

Date

Department Chair  
Dr. Victor Pinheiro
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CHAPTER I

INTRODUCTION

Research shows that individuals who participate in regular physical activity achieve greater health benefits compared to sedentary individuals. According to the American College of Sports Medicine (ACSM), healthy individuals should participate in at least 30 minutes of moderate intensity physical activity, at least three days per week (Haskel et. al., 2007). Regular participation in physical activity reduces the risk of obesity, hypertension, congestive heart failure, atherosclerosis, and cardiovascular disease (Thompson, Gordon, & Pescatello, 2010). Furthermore, regular exercise can decrease the risk of falls, fractures, low back pain, and joint injuries in adults by improving balance and strength. Poor balance and a high fall risk are associated with a sedentary lifestyle (Nitz, Kuys, Isles, & Fu, 2009). Falls are the leading cause of injury deaths secondary to injuries to the head and hip fractures (Hess & Woollacott, 2005).

Research shows that fifty percent of adults over the age of 80 years fall each year and more than 1.6 million seniors were treated in emergency departments for fall-related injuries (Hess & Woollacott, 2005). It is important for clinicians to develop practical rehabilitation tools to help prevent the risk of falls in the older adult population and increase lower body strength. One study of nursing home residents with a history of falling found that muscular force was
significantly decreased in quadriceps, hamstrings, and the tibialis anterior, which are all important muscles that contribute to balance ability (Hess & Woollacott, 2005). It is suggested that strength training is the most important component of exercise in the adult population because it does significantly improve balance and functional ability.

Recently there has been an increase in the development of physically interactive gaming systems. Wii Fit Plus, a follow-up to the initial Wii Fit, was released for the Nintendo Wii in North America in 2009. The Nintendo Wii combines player’s total body movements with motion sensitive joysticks which elicits virtual in-game response (Barkley & Penko, 2009). Wii Fit Plus uses a combination of a balance board and joysticks to allow players to undergo different exercise protocols. The original Wii Fit is currently the third bestselling console game in history, while Wii Fit Plus is the seventh bestselling (Nintendo Co., Ltd., 2010). The sales records indicate the extreme popularity of the Wii Fit franchise and its use as an alternative form of exercise.

A complete physical fitness program in adults should include cardiovascular endurance, muscular strength, flexibility, and balance training (Clark, 2007). The Wii Fit Plus incorporates all of these components through programs such as yoga, strength training, aerobics, and balance training.

The purpose of this study was to determine if the adult population can increase strength and balance after utilizing a Wii Fit Plus exercise protocol. Can the Wii Fit Plus be used as a practical alternative to traditional exercise? It is
important to explore alternative forms of exercise because public facilities can be too expensive to utilize. One study shows that easy access to a facility or equipment was a major factor in compliance with an exercise program (Nitz et al., 2009). Since the Wii Fit Plus is easily accessible and relatively inexpensive, it has the potential to be an alternative exercise tool if proven to be effective. Furthermore, it can also be significant in determining if the Wii Fit Plus can be used as a tool for rehabilitation of leg strength and balance or as a preventative exercise tool to decrease the risk of falls related to poor balance. It was hypothesized that the experimental population will experience greater improvements in balance and lower extremity strength as compared to the control population.
According to the ACSM, all healthy adults between the ages of 18 and 65 need activities that maintain or increase muscular strength and muscular endurance at least two days a week on nonconsecutive days (Haskel et. al., 2007). Muscular strength is the most important health-related component of physical fitness in the older-adult population because it does more to promote independent living than other fitness components. The ACSM defines muscle strength as the maximal force that can be generated by a specific muscle or muscle group during a single movement (Thompson et al., 2010).

Research indicates that approximately one percent of muscle mass is lost per year after the age of forty (Seguin & Nelson, 2003). Strength training has several important benefits in the adult population including maintaining or increasing muscle mass, bone mass, muscular strength, flexibility and dynamic balance. Strength training also decreases the risk of arthritis, Type 2 Diabetes, osteoporosis, sleep disorders and chronic diseases (Seguin & Nelson, 2003). Strength training is especially important in the older adult population because it has been shown to reduce the risk of falls, low back pain, and injury. Overall, it
improves functional performance, mobility, quality of life and self-efficacy to promote independent living in the older adult population (Park, Kim, Komatsu, Park & Mutoh 2008).

Studies have shown that strength and balance training can have a positive effect on one another (Hess & Woollacott, 2005). Participation in a balance program has also improved lower leg strength. Additionally, a lower leg strength program will also result in improvements in balance and postural stability (Park et al., 2008). No specific recommendations for exercise incorporating balance training into an exercise prescription exist, but the ACSM suggests that neuromuscular training is effective in reducing and preventing falls if performed 2-3 days per week (Haskel et. al., 2007). Neuromuscular training incorporates balance, agility, and proprioceptive training. Proprioception is the body’s ability to sense the position of a joint in space (Prentice, 2006).

Research demonstrates that exercise, in general, improves balance function and gait ability for the adult population (Park et al., 2008). Balance training prevents the risk of sustaining fall related fractures due to impaired balance (Heitkamp, Hortsmann, Weller & Dickhuth, 2001). The Wii balance board has been integrated in many rehabilitation programs to improve balance defects and has been shown to be a reliable and inexpensive way to improve neuromuscular control (Clark et al., 2009).
Past studies on physically interactive video games have shown positive outcomes on the physiological benefits of exercise (Barkley & Penko, 2009; Miyachi, Yamamoto, Ohkawara, & Tanaka, 2010; Penko & Barkley, 2010). Miyachi et al. (2010) found the MET level achieved playing a physically interactive video game can be used to meet the ACSM guidelines of 3-6 METS for light to moderate exercise (Thompson et al., 2010). Long term exercise programs at 3-6 METs can promote weight loss (Thompson, et al., 2010). The MET level indicates a metabolic equivalent, which is a measure of energy expense during physical activity. Other research has compared traditional exercise programs to a Wii Fit exercise program and found the Wii Fit to be effective in terms of METs generated (Rogers, Slimmer, Amini, & Park, 2010). A study comparing the physiological responses of Wii Sports boxing, sedentary video games, and treadmill walking in children 8-12 years old showed greater physiological benefits in heart rate and maximal oxygen uptake than walking on a treadmill and playing a sedentary video game (Penko & Barkley, 2010). Individuals also indicated that they were more motivated to exercise using the Wii, than using the more traditional form of exercise (Penko & Barkley, 2010).

Studies on the Wii Fit demonstrate that the most significant benefits of a Wii Fit exercise protocol have been on improvements in balance and strength in both young and older adults (Gokey & Odland, 2010; Odland, Adams, Woods, & Sears, 2010; Rogers et al., 2010). Nitz et al. (2009) found that the Wii Fit
significantly increased balance and strength with improvements in fitness, functional mobility, and sensory measures in females 30-60 years old. They also found a trend in weight loss began because of an increase in physical activity.

There is a plethora of research that indicate positive physiological health benefits associated with the Wii Fit (Barkley & Penko, 2009; Gokey & Odland, 2010; Nitz et al., 2009; Odland et al., 2010; Penko & Barkley, 2010; Roger et al., 2010). More specifically, research has shown greater benefits in balance and strength (Gokey & Odland, 2010; Odland, et al., 2010; Nitz et al., 2009; Rogers et al., 2010). Although there have been positive outcomes of the Wii Fit, to our knowledge no studies exist demonstrating the outcomes of the Wii Fit Plus, the follow up to Nintendo’s Wii Fit. This study examined the effects of the Wii Fit Plus on lower extremity strength and balance in the adult population.
CHAPTER III

METHODS

Participants: The study was approved by the University of Akron’s Institutional Review Board for the protection of human subjects (Appendix A) and consisted of 28 individuals, males (n = 4), females, (n = 24), aged 40 – 63. Participants were recruited from The University of Akron's ZipFit program through email (Appendix B). If the desired sample size was not achieved through ZipFit members, family, coworkers and friends were recruited. The first 28 people to respond and meet all eligibility requirements were accepted for participation.

Participants were eligible if they had no contraindications to exercise testing such as heart disease, uncontrolled metabolic disease, neuromuscular, current musculoskeletal, or rheumatoid disorders that are exacerbated by exercise. Additionally, participants needed to commit 30 minutes a day, two scheduled days a week, for 10 weeks. Participants were informed of the potential risks and benefits of the study prior to signing an informed consent (Appendix C). Exercise group participants were required to complete a Physical Activity Readiness Questionnaire PAR-Q form (Appendix D). All participants had their physical activity level assessed prior to the protocol using a Godin Leisure Time physical activity questionnaire (Godin & Shepard, 1997) (Appendix E). Diet
was also assessed by completing a standard questionnaire (Appendix F). Data from any participant who did not attend three or more sessions was considered invalid, and their participation in the study was terminated.

Participants were divided into a control (n=14) and experimental group (n=14) based on their pre-test Godin Leisure Time Physical Activity questionnaire. Groups were stratified such that both groups consisted of equal numbers of active and sedentary individuals.

Pre-intervention balance and strength variables were measured on all participants, however only the experimental group underwent the Wii Fit Plus exercise protocol. Both groups were encouraged to continue their standard activities of daily living and to eat and drink as normal.

*Program Design:* Strength was measured using the Biodex Multi-Joint System Pro which uses a computerized dynamometer to measure peak torque (highest muscular force output at any moment during repetition) (Biodex, Shirley, NY). Isometric muscular strength was measured at maximum muscle force produced at both the agonist and antagonist muscles of knee flexion and extension. Measurements were taken at 45˚ and 90˚ since muscle force generated is different depending on the length of the muscle. An isometric contraction is a static contraction of the muscle, without change in length (Prentice, 2006). Isometric muscle contraction was used to obtain a maximum value of knee flexion and extension because it is less dependent on range of
motion, reaction time, cognitive-impairment, or pain (Gerdham, Ringsberg, Akesson, & Obrant, 2003). Muscle strength of the tibialis anterior and peroneals was measured by participants performing isometric inversion (tibialis anterior) and eversion (peroneals) exercises. Each participant performed five repetitions of each, holding for five seconds. All measurements followed standard protocol as determined by Biodex (Shirley, NY) using the participant’s dominant side for all strength variable measurements.

Balance was measured using the Biodex Balance System SD (Shirley, NY). Participants were asked to perform three trials of the postural stability test (two-leg stance) where they stood on an unstable platform for thirty seconds per trial. The platform stability was set at an eight out of twelve (one is the least stable and twelve is the most stable) (Biodex, Shirley, NY). These are the standard parameters suggested in the Biodex Balance System manual. Overall stability index was obtained which includes displacement from level in the sagittal and frontal planes. The stability index has two parts, a high number in the frontal plane indicates poor neuromuscular control of the quadriceps and hamstring muscles and a high number in the sagittal plane indicates poor neuromuscular control of inversion/eversion muscles of the lower leg. The Overall Stability Index (SI) can be compared to age related normative ranges (1.5-3.0) to determine the subject’s balance ability as compared to their peer group (Biodex, Shirley, NY) (Appendix G). SI represents the variance of foot platform displacement in
degrees, from level, in all motions during a test. A high number is indicative of a lot of movement during a test with the static measures; it is the angular excursion of the individual’s center of gravity.

The exercise protocol consisted of an eight week program utilizing the balance games, strength training, aerobic training, and yoga programs provided by the Wii Fit Plus. Both experimental and control groups had their leg strength and balance measured prior to the exercise protocol (week 1) and after the eight weeks designated for the exercise protocol (week 10). During weeks two through nine, experimental participants performed 40 minutes of Wii Fit Plus exercise on two days out of the week. Weekly, one day of exercise included exercises from the strength and yoga categories (15 minutes each) and the other day included exercises from the balance and aerobic categories (15 minutes each). A warm up and cool down was performed every day (5 minutes each) using light aerobic exercises. Heart rate and Rate of Perceived Exertion (RPE) was monitored after the experimental participant completed each category of exercise each day. Heart rate was measured using the radial pulse. RPE was measured using the Borg scale (Dunbar et al., 1992) (Appendix H). The experimental participants were divided into two groups. Group 1 included 8 participants who exercised on Monday and Wednesday and Group 2 included 6 participants who exercised on Tuesday and Thursday. Control group participants did not perform the Wii Fit Plus exercise in between the variable measurement
weeks. Both groups of participants were allowed to exercise and/or live their normal lifestyle outside of the study. The experimental participants were under direct supervision of a research investigator at all times and completed the diet and Godin leisure physical activity questionnaire weekly to monitor significant changes in diet and activity level outside of the study. The control group was only required to complete these forms during the pre-testing and post-testing weeks.

The duration of time spent in each exercise category remained constant throughout the eight weeks of exercise. The specific games and exercises performed during each exercise category were selected by the study coordinators. The first two weeks of games and exercises performed were relatively simple and selected in order to allow participants to become familiar with the Wii Fit Plus user interface. Games were set at the beginner level. Based on observing the participants, comparing the participant’s perceived exertion ratings, and reviewing participants exercising heart rate levels, investigators slightly modified the exercise log on a bi-weekly basis in order to increase the intensity of the exercises to compensate for participant’s physiological adaptations. Participants received a new workout log on the first day of exercise every two weeks (Appendix I). All exercise participants followed the same exercise protocol throughout the exercise period. During the final weeks of exercise intervention, participants were performing advanced level exercises. Intensity was based on the settings of ‘beginner’ or ‘advanced’
programmed by the Wii Fit Plus. Different aerobic activities were selected on a bi-weekly basis for the warm up and cool down, however all warm up and cool down activities required users to perform the same total body motions as the ‘basic run’ activity, which is a light jogging exercise in the aerobic games category of the Wii Fit Plus.

**Statistical Design:** The statistical analysis aims to answer four questions:

1.) Is there a significant difference between the experimental group’s week one and week ten variables?

2.) Is this experimental difference significant when taking into account the difference observed in the control group?

3.) Are there any differences between the sedentary individuals and active individuals in the experimental group?

The statistical analysis was performed using an Independent sample t-test to measure the mean differences of each group over time and a repeated measure ANOVA to measure differences within groups over time. Statistical significance was *a priori* set at $p < 0.05$ using SPSS.

Due to lack of attendance, data from one member of the exercise group was excluded from the statistical analysis. Also, two members of the control group were unable to return for post-test measurements resulting in the exclusion of their data. Results of the study were based on thirteen experimental group participants ($n=13$) and twelve control group participants ($n=12$).
CHAPTER IV
RESULTS

The purpose of the present investigation was to examine the effects of a Wii Fit Plus exercise protocol on lower body strength and balance. Participants were assigned to either an exercise or control group using the Godin Leisure Time Physical Activity Questionnaire. The exercise group followed an eight week Wii Fit Plus exercise protocol, while the control group participated in normal daily activity. Pre and post intervention assessments were collected for the following dependent variables: quadriceps and hamstring strength at 45° and 90°, peroneal strength, tibialis anterior strength, anterior/posterior balance index, medial/lateral balance index, and overall balance index. Twenty-five participants completed the investigation, males (n=3), females (n=22), with a mean age of 51.6 ± 5.89. No significant differences were observed between groups regarding participant’s age $F(1,23)=2.78$, $p=0.11$ and gender $F(1,23)=0.27$, $p=0.61$. The initial Godin Leisure-Time Physical Activity Questionnaire results indicated no significant difference between group’s regarding activity level $F(1,23)=0.00$, $p=1.00$. The majority of participants indicated that they ‘sometimes’ engage in regular activity long enough to work up a sweat, which increases heart rate, during a seven day
period. Consequently, an equal amount of sedentary and physically active people were in each group. Pre and post strength and balance means are presented in Table 1.
Table 1

*Pre and post strength and balance means*

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Pre</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Quad 45</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>12</td>
<td>57.7±24.9</td>
<td>54.5±14.3</td>
</tr>
<tr>
<td>Experimental</td>
<td>13</td>
<td>45.4±14.3</td>
<td>54.0±18.6</td>
</tr>
<tr>
<td><strong>Quad 90</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>12</td>
<td>104.8±43.1</td>
<td>93.3±26.4</td>
</tr>
<tr>
<td>Experimental</td>
<td>13</td>
<td>84.6±42.8</td>
<td>97.0±29.1</td>
</tr>
<tr>
<td><strong>Hamstring 45</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>12</td>
<td>49.5±18.7</td>
<td>51.6±23.2</td>
</tr>
<tr>
<td>Experimental</td>
<td>13</td>
<td>42.7±12.5</td>
<td>50.3±13.9</td>
</tr>
<tr>
<td><strong>Hamstring 90</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
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<td>40.9±13.9</td>
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<tr>
<td>Experimental</td>
<td>13</td>
<td>38.7±13.2</td>
<td>40.7±12.1</td>
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<tr>
<td>Control</td>
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<td>14.1±4.5</td>
<td>12.2±2.6</td>
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<tr>
<td>Experimental</td>
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<td>13.2±7.0</td>
<td>13.2±3.7</td>
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<tr>
<td>Control</td>
<td>12</td>
<td>10.9±3.4</td>
<td>10.0±3.5</td>
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<tr>
<td>Experimental</td>
<td>13</td>
<td>9.9±2.9</td>
<td>10.5±4.9</td>
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<td><strong>AP Index</strong></td>
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<tr>
<td>Control</td>
<td>12</td>
<td>1.5±0.8</td>
<td>1.5±0.6</td>
</tr>
<tr>
<td>Experimental</td>
<td>13</td>
<td>2.4±1.3</td>
<td>2.0±1.6</td>
</tr>
<tr>
<td><strong>MedLat Index</strong></td>
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<td></td>
<td></td>
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<tr>
<td>Control</td>
<td>12</td>
<td>1.2±0.6</td>
<td>1.2±0.6</td>
</tr>
<tr>
<td>Experimental</td>
<td>13</td>
<td>1.6±0.6</td>
<td>1.3±0.6</td>
</tr>
<tr>
<td><strong>Overall Index</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>12</td>
<td>2.1±1.0</td>
<td>2.1±0.9</td>
</tr>
<tr>
<td>Experimental</td>
<td>13</td>
<td>3.2±1.5</td>
<td>2.6±1.8</td>
</tr>
</tbody>
</table>
Table 2 depicts the results of the independent samples *t*-tests that were conducted to evaluate the differences in strength and balance variables week one to week ten between the control (*n*=12) and experimental (*n*=13) groups.

Table 2

*Independent Samples t*-test

<table>
<thead>
<tr>
<th>Variable</th>
<th><em>t</em></th>
<th><em>df</em></th>
<th><em>p</em></th>
</tr>
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<tbody>
<tr>
<td>Quad45</td>
<td>-1.58</td>
<td>23</td>
<td>0.13</td>
</tr>
<tr>
<td>Hamstring45</td>
<td>-0.80</td>
<td>23</td>
<td>0.43</td>
</tr>
<tr>
<td>Quad90</td>
<td>-2.60</td>
<td>23</td>
<td>0.02*</td>
</tr>
<tr>
<td>Hamstring90</td>
<td>-1.87</td>
<td>23</td>
<td>0.08</td>
</tr>
<tr>
<td>Peroneals</td>
<td>-0.31</td>
<td>23</td>
<td>0.76</td>
</tr>
<tr>
<td>AntTib</td>
<td>-0.82</td>
<td>23</td>
<td>0.42</td>
</tr>
<tr>
<td>AntPostIndex</td>
<td>-1.13</td>
<td>23</td>
<td>0.27</td>
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<tr>
<td>MedLatIndex</td>
<td>-1.47</td>
<td>23</td>
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</tr>
<tr>
<td>OverallIndex</td>
<td>-1.44</td>
<td>23</td>
<td>0.16</td>
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</tbody>
</table>

*Indicates Significance*

The experimental group demonstrated greater (*p*=0.02) gains in quadriceps strength at 90° (8.28 ± 15.8) than the control group (-11.57 ± 22.0). No significant gains were observed (*p*≥0.08) in all other dependent variables for lower extremity strength and balance.
Table 3 shows the mean difference in muscular strength of the control and experimental groups. Quadriceps, hamstring, and tibialis anterior strength all showed greater improvements in the experimental group compared to the control group, and peroneal strength decreased in both groups.

Table 3

*Mean Differences in Muscle Strength*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control</th>
<th>Experimental</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N = 12</td>
<td>N = 13</td>
</tr>
<tr>
<td>Quad45</td>
<td>-3.18 ± 20.39</td>
<td>8.28 ± 15.8</td>
</tr>
<tr>
<td>Hamstring45</td>
<td>1.82 ± 11.56</td>
<td>6.02 ± 14.34</td>
</tr>
<tr>
<td>Quad90</td>
<td>-11.57 ± 22.03</td>
<td>8.28 ± 15.81</td>
</tr>
<tr>
<td>Hamstring90</td>
<td>-2.36 ± 6.84</td>
<td>2.04 ± 4.83</td>
</tr>
<tr>
<td>Peroneals</td>
<td>-0.88 ± 5.14</td>
<td>-2.62 ± 5.02</td>
</tr>
<tr>
<td>Tibialis Anterior</td>
<td>-0.24 ± 2.07</td>
<td>0.75 ± 3.67</td>
</tr>
</tbody>
</table>

Table 4 shows the mean difference in balance of the control and experimental groups. There were greater improvements in the anterior/posterior index, medial/lateral index, and overall index in the experimental group, as compared to the control group. Figure’s 1 and 2 illustrate these differences for muscle strength and balance.
Table 4

*Mean Differences in Balance*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control</th>
<th>Experimental</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N = 12</td>
<td>N = 13</td>
</tr>
<tr>
<td>Anterior/Posterior Index</td>
<td>0.09 ± 0.46</td>
<td>0.39 ± 0.78</td>
</tr>
<tr>
<td>Medial/Lateral Index</td>
<td>0.02 ± 0.53</td>
<td>0.35 ± 0.59</td>
</tr>
<tr>
<td>Overall Index</td>
<td>0.10 ± 0.71</td>
<td>0.56 ± 0.87</td>
</tr>
</tbody>
</table>

Figure 3 illustrates mean difference in knee strength from pre to post-test in the experimental group. Figure 4 illustrates the mean difference in ankle strength from pre to post-test in the experimental group. Figure 5 illustrates the mean difference in balance from pre to post-test in the experimental group. Although not all variables showed significance, trends towards significant improvement were observed in all dependent variables except for peroneal strength.

The results of repeated measures ANOVA demonstrate a main effect of time ($p = 0.05$) for hamstring strength at 45°. Additionally, a significant ($p=0.01$) interaction effect, group by time, was also observed for quadriceps strength at 90° with the experimental group exhibiting a greater difference over time. No additional main or interaction effects were seen ($p ≥ 0.06$).
Figure 1. Mean Difference in Muscle Strength

Figure 2. Mean Difference in Balance
**Figure 3.** Experimental Group Pre-test vs. Post-test Knee Strength

**Figure 4.** Experimental Group Pre-test vs. Post-test Ankle Strength
Figure 5. Experimental Group Pre-test vs. Post-test Balance
CHAPTER V
SUMMARY

The purpose of this study was to examine the effects of an eight week, two sessions per week, Wii Fit Plus exercise program on lower leg strength and balance. All variables, except for peroneal strength, showed positive mean differences in the experimental population. Only quadriceps strength showed significant changes. Limitations to the study such as population size, frequency and duration of exercise, intensity level of the Wii Fit Plus, participation in outside activity, gender differences, and neuromuscular adaptations are possible explanations for the obtained results.

Although improvement was observed in most variables the majority did not reach significance. This may be due to inadequate sample size or length of the exercise intervention. Participants took part in the Wii Fit Plus exercise protocol two days per week, but only performed each of the four categories (yoga, strength, aerobics, and balance), one day per week, fifteen minutes each. Due to time constraints and limited resources, the protocol was not able to meet American College of Sports Medicine recommendations for frequency and
duration of exercise. Healthy adults between the ages of 18 and 65 should participate in strength and balance training two to three days per week (Haskel et. al., 2007).

The intensity level of exercise was gradually increased on a biweekly basis for the exercise group. By the final week of the exercise protocol, all exercise participants were following advanced level settings on the Wii Fit Plus. Participants’ weekly recorded heart rate and RPE remained consistent and relatively low throughout the intervention period, suggesting that the intensity levels set by the Wii Fit Plus may not be strong enough to elicit significant changes in strength and balance. Increased frequency, duration, and potential for increased intensity may encourage stronger exercise response.

Individual exercise response is another important factor to consider. In this study, there were equal sedentary and active individuals in each group. Sedentary and active individuals were determined by the Godin Leisure Time Physical Activity Form. The activity level of both the exercise group and the control group remained the same throughout the ten week protocol. Neuromuscular adaptations suggest that initial gains in strength during resistance training are based on improved neuromuscular function (Heitkamp et al., 2001). Untrained individuals will experience more significant gains in strength during the first few weeks of training than trained individuals (Brooks, Fahey, & Baldwin 2005). The experimental group as a whole may have experienced improvements in strength, but the sedentary individuals may have
shown greater improvements because of neuromuscular adaptations. Future studies should examine the effect of the Wii Fit Plus on active versus sedentary individuals.

The exercise group included eleven females and only two male participants. Although men tend to have greater muscular strength than women, during the first few months of training, males and females experience the same relative amount of strength gains in response to training (Brooks et al., 2005). Future research should consider gender differences and response to exercise for trained individuals, but for untrained individuals, men and women will respond to strength training at the same rate at the initiation of an exercise program (Brooks et al., 2005).

The Wii Fit Plus may be a good supplement to exercise, however, based on the results of this study, should not be the only alternative for individuals who regularly participate in exercise. Evidence from the current investigation suggests the Wii Fit Plus may be a valuable mode of exercise and, improvements in lower leg strength and balance also suggest possible clinical application in rehabilitation and injury prevention for the lower extremity. The results of this study showed small improvements in quadriceps, hamstring and tibialis anterior strength, which are all important muscles that contribute to stabilization and balance ability (Hess & Woollacott, 2005). Future studies should examine the use of the Wii Fit Plus as a tool for improving balance, proprioception, and functional deficiencies in the knee or ankle. Improved
muscle balance is an important part of injury prevention. In a study focusing on balance training, participants described feeling improvements in stability which may have been caused by an increase in strength and muscle balance (Heitkamp et al., 2001).

Throughout the course of the study, there were many subjective observations made by the investigators and research participants. Many of the balance games took into account reaction time and coordination, which are important factors in concussion assessment. Recent research supports the use of the Wii Fit as a tool for assessing balance and coordination for concussion evaluations and return to play decisions (Adams, 2011). On the contrary, research has been done on cognition and outside stimulus that may impair cognitive recovery. Activities, such as video games, text messaging and school work may exacerbate symptoms and delay recovery (McCrory et al., 2009). Although the Wii Fit Plus can be a good tool for the physical aspect of concussion measurement such as coordination and balance, it may have negative effects on cognitive recovery. Future research can compare the benefits of the Wii Fit Plus as a beneficial tool for concussion assessment and the possible impedance of cognitive recovery.

Research participants found the Wii Fit Plus an enjoyable activity to get back into exercise and their competitive nature was a motivating factor to participate. Future studies should consider the motivational aspects of exercise. Penko and Barkley (2010) found that children experienced greater liking while
taking part in Wii Sports boxing compared to treadmill walking. Motivational aspects and liking are important factors to understand ways to promote exercise among all populations.

Based on the findings of the present investigation, the following recommendations are proposed for future research:

1. Increase population size to improve the chance for significant outcomes.
2. Increase the duration and frequency of the exercise period to meet ACSM guidelines and elicit greater physiological response.
3. Compare the exercise response of sedentary individuals to physically active individuals and males to females.
4. Further examine the clinical application of the Wii Fit Plus.
5. Examine motivational aspects of exercise using the Wii Fit Plus.
REFERENCES


APPENDIX A

IRB NOTICE OF APPROVAL
NOTICE OF APPROVAL

November 30, 2010

Brandon Pollock
876 Mt. Pleasant Road
Clinton, Ohio 44216

From: Sharon McWhorter, IRB Administrator

Re: IRB Number 20101111 "Physiological Effects and Practicality of the Wil Fit Plus as an Exercise Program for Adults"

Thank you for submitting an IRB Application for Review of Research Involving Human Subjects for the referenced project. Your protocol represents minimal risk to subjects and has been approved under Expedited Categories #4/7.

Approval Date: November 29, 2010
Expiration Date: November 29, 2011
Continuation Application Due: November 15, 2011

In addition, the following is/are approved:

☐ Waiver of documentation of consent
☐ Waiver or alteration of consent
☐ Research involving children
☐ Research involving prisoners

Please adhere to the following IRB policies:

- IRB approval is given for not more than 12 months. If your project will be active for longer than one year, it is your responsibility to submit a continuation application prior to the expiration date. We request submission two weeks prior to expiration to insure sufficient time for review.
- A copy of the approved consent form must be submitted with any continuation application.
- If you plan to make any changes to the approved protocol you must submit a continuation application for change and it must be approved by the IRB before being implemented.
- Any adverse reactions/incidents must be reported immediately to the IRB.
- If this research is being conducted for a master’s thesis or doctoral dissertation, you must file a copy of this letter with the thesis or dissertation.
- When your project terminates you must submit a Final Report Form in order to close your IRB file.

Additional information and all IRB forms can be accessed on the IRB website at:
http://www.uakron.edu/research/orssp/compliance/IRBHome.php

Cc: Judith A. Juvancic-Heltzel - Advisor
Cc: Renee DeSalvo/Nick Potenzini - Co PI's
Cc: Stephanie Woods - IRB Chair

☐ Approved consent form/s enclosed

Office of Research Services and Sponsored Programs
Akron, OH 44325-2102
330-972-7666 • 330-972-6281 Fax
The University of Akron is an Equal Education and Employment Institution
APPENDIX B

ZIP FIT EMAIL
Greetings participants of ZipFit!

The graduate assistants in UA’s Sport Science and Wellness Education Department in coordination with Student Recreation and Wellness Services (SRWS), who sponsor ZipFit, are seeking your help to identify individuals such as yourself who have been part of ZipFit and may be interested in participating in a study involving the Nintendo Wii Fit Plus interactive game system. This purpose of this study is for the Master’s Thesis for three graduate assistants in the Sport Science and Wellness Department. The Wii Fit Plus is an exciting new follow-up to the original Wii Fit released in 2009. The Wii Fit Plus is a video game system that makes exercise fun! Players will use a combination of the Wii’s joysticks and balance board as a means to exercise, while at the same time enjoying the fun on-screen aspects of a video game. Currently, little research exists pertaining to the Wii Fit Plus, so participants will be among the first to study the fun and fitness capabilities of the Wii Fit Plus.

For more information regarding the Nintendo Wii Fit Plus, please visit:

http://www.wiifit.com/

The Wii Fit Plus Study:

The purpose of the study is to evaluate the WiiFit Plus as a practical alternative to traditional exercise. The study will begin the week of January 3rd, 2011 and progress through early March (10 Weeks). The intensity of exercise associated with the Wii Fit Plus is light. All qualifying participants will be given 2 FREE assessments from SSWE graduate assistants at InfoCision Stadium 407 (once at the beginning and once at the end of the study). The tests will be conducted using advanced laboratory equipment. Note that these tests will provide you with valuable information regarding your overall health and risk factors for related conditions/diseases. Here is a list of the tests that you will be receiving:

- Body Composition
- Resting Blood Pressure
- Leg Strength
- Balance Capability
- Flexibility
- Bone Density

Participant Qualifications:

In order to participate in the study, individuals must meet the following criteria:

- Aged 45 or above.
- Have no contraindications to exercise such as diagnosed heart disease, osteoporosis, osteopenia uncontrolled metabolic disease, neuromuscular disease, current musculoskeletal or rheumatoid disorders that are exacerbated by exercise.
- Can commit just 40 minutes a day, two scheduled days a week (Further details below).

Upon admittance into the study you will be required to sign an informed consent form, a Physical Activity Readiness Questionnaire (PAR-Q), Godin Leisure Time Physical Activity Questionnaire and a weekly dietary log.

Participants will be placed into the experimental (exercise) group or the control group. During weeks one and ten both groups will have the following assessed: body composition, resting blood pressure, balance, leg strength, flexibility and bone mineral density.
If you are in the **experimental group** you will then be assigned to either a Monday / Wednesday group or a Tuesday / Thursday group. During weeks 2 – 9 participants in the experimental group will report to the 4th floor of InfoCision Stadium and participate in 40 minutes of Wii Fit Plus activity on your assigned days. We will try to accommodate your schedules. During week 10, the experimental group will have repeat measurements of the six variables. If you are assigned to the **control group**, the following will be measured during weeks one and ten: body composition, resting blood pressure, balance, leg strength, flexibility and bone mineral density. The control group will not participate in the Wii Fit Plus protocol during weeks 2 – 9.

**Participants in both groups are PERMITTED to continue normal daily activities including regular exercise or physical activity. NO dietary or exercise restrictions will be imposed.**

**The Schedule:**

Week 1: January 3rd 2011. (Pre-test data collection for both groups)

Week 2: January 10th 2011.

Week 3: January 17th 2011.

Week 4: January 24th 2011.

Week 5: January 31st 2011.

Week 6: February 7th 2011.

Week 7: February 14th 2011.

Week 8: February 21st 2011.


Week 10: March 7th 2011. (Post-test results collection for both groups)

**Selection:**

The Wii Fit Plus study has IRB approval and is currently enrolling qualifying participants. Study participation is limited; participants will be recruited on a first-come first serve basis. The study requires 40 participants (20 per group). We will be taking the names of the first 60 individuals who contact us; the first 40 individuals who qualify for the study will be contacted with further information.

What a great way to start that the New Year! If you are interested please contact:

Brandon Pollock        bsp12@zips.uakron.edu        330 – 575 – 9348

‘Wii’ would love your help, and thank you!
APPENDIX C

INFORMED CONSENT
Title of Study: “Physiological Effects and Practicality of the Wii Fit Plus as an Exercise Program for Adults”

Introduction: Welcome to the Wii Fit Plus Study conducted by graduate assistants of the Sport Science and Wellness Department!

Purpose: The purpose of the study is to determine if the Wii Fit Plus can be used to show improvements in the fitness of an adult population following a 10-week exercise program.

Procedure: You will be assigned to either the exercise group or the control group. On your initial visit we will perform a variety of tests to obtain baseline information so that we will be able to compare the results from before the exercise protocol to the results after the exercise protocol. Upon arriving at the laboratory, your body composition will be assessed using a tool called the BOD POD. This machine is very simple and uses air displacement to estimate body composition. Once inside the body composition machine you will be sitting for two short 45 second tests as motionless as you can sit. Blood pressure and heart rate will be assessed just like in a doctor’s office. Blood pressure will be measured using sphygmomanometer and stethoscope on your arm. Your resting heart rate will be assessed using a stopwatch and wrist pulse. Flexibility will be assessed using a test called the Sit-and-Reach. All you will be doing is simply sitting on the ground and placing your feet up against the back of the equipment with your knees in a locked position you will bend forward from the hips moving a metal piece forward as far as you can to measure flexibility. Bone mineral density will be measured using the QUS-2 Calcaneal Ultrasonometer. The QUS-2 uses ultrasound technology to measure and determine the bone strength in the calcaneus (heel bone). Leg strength will be measured using the Biodex Multi-Joint System Pro; static contractions of the lower leg will be performed. Balance will be measured using the Biodex Balance System SD. You will be asked to perform the designated test while stabilizing yourself on a balance plate. The balance plate is an unstable surface and there will always be a technician and a balance bar in case you experience loss of balance and added support is needed. All assessments will be performed by qualified technicians. These measurements will be assessed during Week 1 and Week 10 of the program. If you are assigned to the experimental group, you will complete two 40 minute exercise sessions per week (Group 1 will be Monday/Wednesday and Group 2 will be Tuesday/Thursday). If you are assigned to the control group, you will not be performing the exercise sessions. You will be permitted to continue your regular exercise and daily activities outside of the study. If you are in the exercise group you may continue your regular exercises in addition to the Wii Fit Plus.

You are eligible for this study if you are ≥ age 45, have no contraindications to exercise such as heart disease, uncontrolled metabolic disease, neuromuscular, current musculoskeletal, or rheumatoid disorders that are exacerbated by exercise. Additionally, you must be able to commit just 40 minutes a day, two scheduled days a week. You will also be required to complete a Par-Q and Godin Leisure Time Physical Activity questionnaire. The Par-Q is simply used for assessing your ability to participate in physically demanding activities. The Godin Leisure Time Physical Activity questionnaire is used for determining your current physical activity level and will be completed weekly. During each exercise session you will be required to where a heart rate monitor, which consists of a strap under your chest and a transmitter on your wrist. At the conclusion of each exercise session we will ask you how much you enjoyed it and how tired you feel.

Risk and Discomfort:
If at anytime you feel uncomfortable while having your body composition measured let us know, we will take all the steps possible to ensure your comfort in this process. Minimal, skin tight clothing is required while undergoing the body composition protocol. This will occur twice throughout the study (week one and week ten). You may also feel a little discomfort if you are uncomfortable in small spaces.
There is a small risk for muscle soreness or muscular injury with flexibility testing and strength testing, if the test is not performed correctly. With proper instruction, injury is unlikely. Both tests take place during week one and week ten of the study.

When testing for bone mineral density you will be at no risk for any injury of any kind. This is primarily because you will be in a sitting position for the duration while a machine takes ultrasound measurements of your ankle.

The Wii Fit Plus exercise protocol poses a small risk of injury among the experimental group. You may experience mild muscular soreness or muscle injury. The chance of injury is unlikely considering the exercise intensity associated with the Wii Fit Plus is low.

**Benefits:** Information will be gathered about your flexibility, bone mineral density, strength, balance, body composition, and blood pressure. These variables are very important for maintaining a healthy lifestyle. These components are especially important in the adult population to diagnose risks for specific conditions such as: osteoporosis, cardiovascular disease and orthopedic injuries of the lower body. If you are planning to begin an exercise program these components are also helpful to establish and baseline and help you identify areas that need improvement.

**Payments for Participation:** There will be no payment for participation.

**Right to refuse or withdraw:** You may withdraw from the study at any time. There is no penalty if you decide to withdraw.

**Anonymous and Confidential Data Collection:** Data will be password protected and stored / accessed electronically only by the study investigators. Any hardcopy form of data such as measurement print-outs will be stored in a locked cabinet in InfoCision Stadium, 307E. Only the study investigators have access to this information.

**Confidentiality of records:** Your records will be password protected and stored / accessed electronically only by the study investigators. Any hardcopy form of your records will be stored in a locked cabinet in InfoCision Stadium, 307E. Only the study investigators have access to this information. If you agree to have your information used as part of the research data, you will be asked to sign this informed consent document.

**Who to contact with questions:** If you have any questions at any time, you may contact any of the following:

Brandon Pollock: (330) – 575 – 9348 or bsp12@zips.uakron.edu
Renee DeSalvo: (440) – 781 – 1689 or rmd18@zips.uakron.edu
Nick Potenzini: (740) – 317 – 5250 or ntp2@zips.uakron.edu
Judith A. Juvancic-Heltzel, Ph.D.: (330) – 972 – 6273 or jaj52@uakron.edu
Thesis advisor

This study has been reviewed and approved by The University of Akron Institutional Review Board (IRB). If you have any questions about your rights as a research participant, you may call the IRB at (330) 972-7666 or 1-888-232-8790.

I have read the information provided above and all of my questions have been answered. I voluntarily agree to participate in this study. I will receive a copy of this consent form for my records.

Signature: __________________________           Date:______________________

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APPENDIX D

PHYSICAL ACTIVITY READINESS QUESTIONNAIRE (PAR-Q)
PAR-Q FORM Please mark YES or No to the following: YES NO

Has your doctor ever said that you have a heart condition and recommended only medically supervised physical activity? ____ ____

Do you frequently have pains in your chest when you perform physical activity? ____ ____

Have you had chest pain when you were not doing physical activity? ____ ____

Have you had a stroke? ____ ____

Do you lose your balance due to dizziness or do you ever lose consciousness? ____ ____

Do you have a bone, joint or any other health problem that causes you pain or limitations that must be addressed when developing an exercise program (i.e. diabetes, osteoporosis, high blood pressure, high cholesterol, arthritis, etc.)? ____ ____

Are you pregnant now or have given birth within the last 6 months? ____ ____

Do you have asthma or exercise induced asthma? ____ ____

Do you have low blood sugar levels (hypoglycemia)? ____ ____

Do you have diabetes? ____ ____

Have you had a recent surgery? ____ ____

If you have marked YES to any of the above, please elaborate below:
______________________________________________________________________________
______________________________________________________________________________

Do you take any medications, either prescription or non-prescription, on a regular basis? Yes/No
What is the medication for?
How does this medication affect your ability to exercise or achieve your fitness goals?
________________________________________________________________________
________________________________________________________________________

Please note: If your health changes such that you could then answer YES to any of the above questions, tell your trainer/coach. Ask whether you should change your physical activity plan.

I have read, understood, and completed the questionnaire. Any questions I had were answered to my full satisfaction.
Name: _________________________________ Date: ____________________
APPENDIX E

GODIN LEISURE TIME PHYSICAL ACTIVITY QUESTIONNAIRE
Godin Leisure Time Physical Activity Questionnaire

Considering a 7-Day Period (a week), how many times on the average do you do the following kinds of exercise for more than 15 minutes during your free time? (write on each line the approximate number)

Times Per Week

1. Strenuous Exercise
   a. (Heart beats rapidly)
   b. Examples: running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling

2. Moderate Exercise
   a. (Not Exhausting)
   b. Examples: fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing

3. Mild Exercise
   a. (Minimal Effort)
   b. Examples: yoga, archery, fishing from river bend, bowling, horseshoes, golf, snow-mobiling, easy walking

4. Considering a 7-Day period, during your leisure-time, how often do you engage in any regular activity long enough to work up a sweat (heart beats rapidly)?
   a. Often
   b. Sometimes
   c. Never/Rarely
APPENDIX F

WEEKLY DIETARY QUESTIONNAIRE
Check any of the following foods if they have been consumed in the past week:

<table>
<thead>
<tr>
<th>Foods (Include servings for all checked foods)</th>
<th>Servings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skim Milk</td>
<td></td>
</tr>
<tr>
<td>Whole Milk</td>
<td></td>
</tr>
<tr>
<td>Yogurt</td>
<td></td>
</tr>
<tr>
<td>Feta Cheese</td>
<td></td>
</tr>
<tr>
<td>Tofu</td>
<td></td>
</tr>
<tr>
<td>Soy Beans</td>
<td></td>
</tr>
<tr>
<td>Instant Oats</td>
<td></td>
</tr>
<tr>
<td>Roasted Almonds</td>
<td></td>
</tr>
<tr>
<td>Almond Butter</td>
<td></td>
</tr>
<tr>
<td>Broccoli</td>
<td></td>
</tr>
<tr>
<td>Orange Juice</td>
<td></td>
</tr>
<tr>
<td>Sardines</td>
<td></td>
</tr>
<tr>
<td>Lasagna</td>
<td></td>
</tr>
<tr>
<td>Pizza w/cheese</td>
<td></td>
</tr>
</tbody>
</table>

Has your diet undergone any dramatic changes within the past week?
(Such as: deciding to become a vegetarian, consuming an unusually high / low amount of food relative to a typical week (maybe an eating contest), become ill or injured restricting nutritional capabilities, restricting any macronutrient (carbohydrate, fat, protein), starting a diet plan, etc.)

Yes / No

If you circled yes, please provide a brief explanation with regards to how:

<table>
<thead>
<tr>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
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</tbody>
</table>
APPENDIX G

BORG SCALE
<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>No exertion at all</td>
</tr>
<tr>
<td>7</td>
<td>Extremely light</td>
</tr>
<tr>
<td>8</td>
<td>Very light</td>
</tr>
<tr>
<td>9</td>
<td>Light</td>
</tr>
<tr>
<td>10</td>
<td>Somewhat hard</td>
</tr>
<tr>
<td>11</td>
<td>Hard (heavy)</td>
</tr>
<tr>
<td>12</td>
<td>Very hard</td>
</tr>
<tr>
<td>13</td>
<td>Extremely hard</td>
</tr>
<tr>
<td>14</td>
<td>Maximal exertion</td>
</tr>
</tbody>
</table>
APPENDIX H
BALANCE INDEX
Balance Index

72-89 yrs.  ▢
54-71 yrs.  □
36-53 yrs.  □
17-35 yrs.  □

Compare your score to the age group of healthy active people.
APPENDIX I

BIWEEKLY EXERCISE LOGS
### Exercise Log (Weeks 2 – 3)

#### Instructions:
- Perform each Wii Fit Plus activity to the best of your ability.
- You MUST spend the noted time limit performing each specific category of exercises. Study conductors will be monitoring time.
- If you happen to finish the list of exercises in a certain category before the required time limit, you should continue to exercise until the study conductor notifies you that time has been reached. At this point you may choose what exercises you wish to perform, however they must fall under your current exercise category.

<table>
<thead>
<tr>
<th>Exercise Category</th>
<th>Day</th>
<th>Warm Up (5 Minutes)</th>
<th>Yoga (15 Minutes)</th>
<th>Strength Training (15 Minutes)</th>
<th>Cool Down (5 Minutes)</th>
</tr>
</thead>
</table>
|                   | Monday / Tuesday | 5 Minutes of 'Basic Run' Activity. | 1) Half-Moon Pose  
2) Palm Tree Pose  
3) Standing Knee Pose  
4) Chair Pose  
5) Sun Salutation Pose | 1) Single Leg Extension  
2) Lunge  
3) Sideways Leg Lift  
4) Rowing Squats  
5) Torso Twists | 5 Minutes of 'Basic Run' Activity. |
|                   | Wednesday / Thursday | 5 Minutes of 'Basic Run' Activity. | 1) Basic Step (5 Minutes)  
2) Hula Hoop (5 Minutes)  
3) Rhythm Boxing (5 Minutes) | 1) Soccer Heading (2 Rounds)  
2) Tightrope Walk (2 Rounds)  
3) Ski Slalom / Snowboard Slalom (2 Rounds of either) | 5 Minutes of 'Basic Run' Activity. |
**Exercise Log (Weeks 4 – 5)**

**Instructions:**
- Perform each Wii Fit Plus activity to the best of your ability.
- You MUST spend the noted time limit performing each specific category of exercises. Study conductors will be monitoring time.
- If you happen to finish the list of exercises in a certain category before the required time limit, you should continue to exercise until the study conductor notifies you that time has been reached. At this point you may choose what exercises you wish to perform, however they must fall under your current exercise category.

<table>
<thead>
<tr>
<th>Exercise Category</th>
<th>Day</th>
<th>Warm Up (5 Minutes)</th>
<th>Yoga (15 Minutes)</th>
<th>Strength Training (15 Minutes)</th>
<th>Cool Down (5 Minutes)</th>
</tr>
</thead>
</table>
|                   | Monday / Tuesday | 5 Minutes of 'FREE RUN' Activity. | 1) Sun Salutation Pose  
2) Chair  
3) The Warrior’s Pose  
4) Standing Knee Pose  
5) The Tree Pose | 1) Torso Twists  
2) Lunge  
3) Side Lunge  
4) Single-Leg Twists  
5) Plank | 5 Minutes of 'FREE RUN' Activity. |

<table>
<thead>
<tr>
<th>Exercise Category</th>
<th>Day</th>
<th>Warm Up (5 Minutes)</th>
<th>Aerobics (15 Minutes)</th>
<th>Balance (15 Minutes)</th>
<th>Cool Down (5 Minutes)</th>
</tr>
</thead>
</table>
|                   | Wednesday / Thursday | 5 Minutes of 'FREE RUN' Activity. | 1) Rhythm Kung Fu (1 round)  
2) Advanced Island Cycling (Get as many flags possible in 5 minutes)  
3) Rhythm Boxing (1 round) | 1) Segway Circuit (1 round)  
2) Tilt City (1 round)  
3) Table Tilt Plus (5 minutes)  
4) Tightrope Walk (5 Minutes) | 5 Minutes of 'FREE RUN' Activity. |
### Exercise Log (Weeks 6 – 7)

**Instructions:**
- Perform each Wii Fit Plus activity to the best of your ability.
- You MUST spend the noted time limit performing each specific category of exercises. Study conductors will be monitoring time.
- If you happen to finish the list of exercises in a certain category before the required time limit, you should continue to exercise until the study conductor notifies you that time has been reached. At this point you may choose what exercises you wish to perform, however they must fall under your current exercise category.

<table>
<thead>
<tr>
<th>Exercise Category</th>
<th>Day</th>
<th>Warm Up (5 Minutes)</th>
<th>Yoga (15 Minutes)</th>
<th>Strength Training (15 Minutes)</th>
<th>Cool Down (5 Minutes)</th>
</tr>
</thead>
</table>
| **Monday / Tuesday** |           | 5 Minutes of Obstacle Course Activity. | 1) Sun Salutation Pose  
2) Chair  
3) The Warrior’s Pose  
4) Standing Knee Pose  
5) The Tree Pose  
6) Sun Salutation Pose | 1) Torso Twists (6 REPS)  
2) Lunge (15 PER LEG)  
3) Side Lunge (15 PER LEG)  
4) Single-Leg Twists (20 PER LEG)  
5) Plank | 5 Minutes of Obstacle Course Activity. |
| **Wednesday / Thursday** |           | 5 Minutes of Obstacle Course Activity. | 1) Birds Eye Bulls Eye  
2) Rhythm Kung Fu (ADVANCED setting)  
3) Rhythm Boxing (ADVANCED setting)  
4) Island Cycling (ADVANCED setting) | 1) Big Top Juggling (2 ROUNDS)  
2) Penguin Slide (2 ROUNDS)  
3) Tilt City (ADVANCED SETTING – 2 ROUNDS)  
4) Table Tilt Plus | 5 Minutes of Obstacle Course Activity. |
## Exercise Log (Weeks 8 – 9)

<table>
<thead>
<tr>
<th>Exercise Category</th>
<th>Day</th>
<th>Warm Up (5 Minutes)</th>
<th>Yoga (15 Minutes)</th>
<th>Strength Training (15 Minutes)</th>
<th>Cool Down (5 Minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wednesday / Thursday</td>
<td>1 Round Rhythm Parade. 2 Minutes Island Cycling (Advanced).</td>
<td>1) 5 Minutes Obstacle Course. [ADVANCED setting] 2) 2 Rounds Rhythm Kung Fu [ADVANCED setting] 3) Super Hula Hoop. [ADVANCED setting]</td>
<td>1) 5 Minutes Bubble Balance Plus. 2) 2 Rounds Penguin Slide. 3) 1 Round Big Top Juggling. [ADVANCED setting] 4) Table Tilt Plus.</td>
<td>1 Round Rhythm Parade. 2 Minutes Basic Run.</td>
</tr>
</tbody>
</table>