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The effect of the Nintendo Wii Fit and exercise in improving balance and quality of life in community dwelling elders

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BOSTON UNIVERSITY
SARGENT COLLEGE OF HEALTH AND REHABILITATION SCIENCES

Thesis

**THE EFFECT OF THE NINTENDO WII FIT AND EXERCISE IN
IMPROVING BALANCE AND QUALITY OF LIFE IN
COMMUNITY DWELLING ELDERS**

by

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B.S., University of Rhode Island, 2009

Submitted in partial fulfillment of the
requirements for the degree of
Master of Science in Occupational Therapy

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ABSTRACT

Objective: The aim of this research study was to see if Nintendo Wii Fit is better able to improve balance in the elderly population when compared to the Matter of Balance program, which is evidence-based and designed to promote health, balance and well-being to decrease the risk of falls.

Participants: Residents of an independent living senior housing facility in the Boston area were recruited to participate in this study. A total of 32 residents ages 63 to 90 participated: Wii Fit n=11, Matter of Balance n=11, and Control n=10.

Methods: Participants were separated into three groups. Experimental group 1: The Wii Fit Group performed balance games on the Wii Fit in individual sessions twice a week for three weeks. Experimental group 2: The Matter of Balance Group performed exercises from the Matter of Balance Program in a group setting twice a week for three weeks. The control group received no intervention. Participants in the Wii Fit group had the addition of supplemental home exercises. Two balance and one health and wellness measure were used to determine whether there were any changes following intervention: the Berg Balance Scale, the Tinetti Gait and Balance Assessment, and the Short Form-36 Health Survey (SF-36).

Results: Repeated measures ANOVAs were used to determine whether there was an effect of the interventions on balance, health and well-being and whether there were any differences between intervention groups. Scores were significantly improved at post-test for both balance assessments: Berg Balance Scale ($F_{(1,29)} = 17.034, p < 0.001$); Tinetti Gait and Balance Assessment ($F_{(1,29)} = 9.715, p < 0.004$). The mean increases in balance scores were larger, but not significantly so, for the exercise groups as compared to the control group. Results from the Wii Fit Enjoyment Questionnaire showed that 81% of participants reported high levels of enjoyment while playing the Wii games.

Discussion and Conclusion: The Wii Fit is an enjoyable form of exercise as self-reported from an elderly population. Balance improved in the Wii Fit group following intervention, but only a small amount and not significantly more than improvements made by the MOB-exercise and non-exercise control groups. It is likely that the three-week duration of the Wii Fit intervention was too short a period to make a large and significant impact on elders' balance.

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Introduction

Over 35.9 million Americans are 65 years or older (He, Sengupta, Velkoff, & DeBarros, 2005). The elderly population is defined to include those with a chronological age of 65 years and older (World Health Organization, n.d.). The elderly population is rapidly increasing and currently makes up 12% of the population (He et al., 2005). By 2030 the number is estimated to grow to 72 million and represent about 20% of the population (He et al., 2005).

An important health problem for the older population is that there are changes in balance and an increase in fall risk that increases with each decade over age 60 (Era, Heikkinen, Gause-Nilsson, & Schroll, 2002; Carter, Kannus, & Khan, 2001; Baloh, Jacobson, Enrietto, Corona, & Honrubia, 1998; Pyykko, Jäntti, & Aalto, 1990). A fall is defined as any unintentional positional change that results in a person coming to rest on the ground, floor, or other lower surface (Moylean & Binder, 2007). Approximately one third of community-dwelling elders over the age of 65 fall each year resulting in a wide range of consequences, from bruising to fractures; half of these individuals will experience multiple falls (Sturnieks et al., 2010; Costello & Edelstein, 2008; Sherrington et al., 2008; Moylean & Binder, 2007; Lajoie & Gallagher, 2004; Sherrington, Lord, & Finch, 2004). Falls and fall related injuries are a leading cause of non-fatal injury (Lajoie & Gallagher, 2004). It is important to keep in mind that 40-50% of fallers admitted to a hospital will next be admitted to a nursing home (Lajoie & Gallagher, 2004). As a result of falling, a fear of falling is developed, which is an excessive apprehension about falling that causes the person to change their activities even in the absence of physical disability

or injury (Hill, Womer, Russell, Blackberry, & McGann, 2010). This fear usually presents in a cyclical fashion consisting of decreased confidence to complete common tasks, muscle atrophy, impaired balance, and overall reduced quality of life.

(Hadjistavropoulous, Delbaere, & Fitzgerald, 2010; Hill, et al., 2010; Lajoie & Gallagher, 2004). As the elderly population continues to grow, it is prudent to investigate this phenomenon and create a solution that will help decrease the incidence of falls.

Major risk factors and predictors of falls for the elderly population include impaired or decreased mental status, medication side effects, visual impairments, balance and gait impairments, and lower extremity weakness (Lajoie & Gallagher, 2004; Sherrington et al., 2004). The addition of exercise and balance training to a faller's daily life could help address the risk factors of balance and gait impairments and lower extremity weakness.

The aim of this research study was to compare a traditional exercise program, Matter of Balance (MOB) used to improve balance and coordination in the elderly population with the exergaming program Wii Fit.

The Wii Fit is an example of active gaming or 'exergaming', which has begun to gain increasing popularity across all ages, including the elderly population. The Wii Fit features yoga, strength training, aerobics, and balance games. The player stands on the Wii Balance Board, which monitors and tracks the position of the player's center of pressure on the board so that the video monitor can provide the participant with information about their alignment and balance control during the activities. Currently, there is insufficient evidence to determine whether Wii Fit training improves balance in

the elderly population.

The MOB program is an education and exercise program that has been used with the community dwelling elder population with success since 1998. The MOB program focuses on teaching participants practical coping strategies to reduce their fear of falling and risk of falling (Partnership for Healthy Aging, n.d). Early program sessions focus on first changing attitudes and self-efficacy before introducing exercises to improve balance and strength in latter sessions (Partnership for Healthy Aging, n.d). The MOB program has been shown to improve “confidence in managing and controlling falls as well as engaging in everyday activities without falling” (Partnership for Healthy Aging, n.d.). Several studies have shown that participating in the MOB program improves activity levels and increases falls efficacy (Ory et al., 2010; Beling & Roller, 2009; Zijlstra, van Haastregt, van Eijk, & Kempen, 2006; Tennstedt et al., 1998). Beginning sessions of the MOB program use a cognitive restructuring approach to help instill adapted beliefs in participants and educate about self-conception regarding falls (Tennstedt et al., 1998). Following the cognitive restructuring strength training exercises using an elastic resistance band were introduced to help improve strength and balance to reduce falls risk (Tennstedt et al., 1998). The MOB program was chosen as a control exercise group due to its past success in improving falls efficacy and decreasing the fear of falling and current adoption as a large scale community-wide fall prevention program (Ory et al., 2010; Zijlstra et al., 2006; Tennstedt et al., 1998).

Review of the Literature

Balance in Everyday Activities

Balance is the ability to maintain an upright posture against the changing effects of gravity on the body segments (Sabari, 2008). Postural control mechanisms help a person maintain balance by ensuring that the center of gravity is maintained within the base of support (Sabari, 2008). There are three different ways a person's center of gravity can be displaced during the completion of daily activities (1) by an external force applied to the body (i.e., during contact sports), (2) by external movement of the support surface (i.e., when moving from sit to stand), or (3) during activities that require movement of the head limbs, or trunk (Sabari, 2008).

Balance is a complex activity that requires input from many different sensory systems to regulate the relationship between the center of mass and base of support. The four main sensory systems for balance are the vestibular, visual, tactile, and proprioceptive systems (Sabari, 2008; Konrad, Girardi, & Helfert, 1999). Information from the different sensory systems is integrated in the central nervous system, which coordinates movement commands to the musculoskeletal system to perform balance maintenance and correction actions (Konrad et al., 1999). Age-related deterioration of the sensory systems occurs as a person grows older and is one reason why there are changes in balance control and fall risk in the elderly population. (Era et al., 2002; Carter et al., 2001; Baloh et al., 1998; Pyykko et al., 1990). Impaired vision and vision diseases can alter depth perception, visual acuity and peripheral vision, which limits one's ability to safely negotiate the environment (Tremblay & Barber, 2005). Some of these sensory

changes can be repaired or compensated for, however these compensatory abilities also decrease with age; thus balance is a function usually impaired in the older adult (Konrad et al., 1999).

In addition to changes in sensory systems, there are age-related changes in the musculoskeletal and neuromuscular control systems that also affect balance control with advancing age (Konrad et al., 1999). Major changes that occur in the neuromuscular and musculoskeletal systems include a stiffening and loss of elasticity in the tissues, decreased bone density, and a decrease in muscle mass and strength (Thompson, 2008). The elderly are also more susceptible to chronic diseases, such as diabetes, arthritis, osteoporosis, and Alzheimer's disease, that affect their sensory, motor and/or cognitive functions (Konrad et al., 1999). Also decreased physical activity tends to lead to decreased muscle strength and skeletal integrity, which leads to decreased balance, and an increased fall risk (Konrad et al., 1999).

There are several other factors that lead to an increased fall risk in aging individuals. Decreased bone density due to osteoporosis contributes to fractures when falls occur (Tremblay & Barber, 2005). Lack of physical activity leads to poor muscle tone, decreased strength, and loss of bone mass and flexibility (Tremblay & Barber, 2005). Medications can reduce mental alertness and drop systolic blood pressure while standing and lead to a greater fall risk (Tremblay & Barber, 2005). Environmental hazards such as poor lighting, loose rugs, and excess floor clutter increase the chance of falling while in the home (Tremblay & Barber, 2005).

Maintaining Older Adults in Their Home

Independence in the home plays an important role in the quality of life in older adults (Pynoos, Nishita, Cicero, & Caraviello, 2008). People create part of their identity from living in one place for a long period of time and their home becomes a place associated with family and friends (Pynoos et al., 2008).

A survey completed by AARP in July 2010 compiled the responses from 1,616 adults' ages 45 and older (AARP, 2010). Nearly three-quarters (73%) of respondents *strongly agreed* with the statement "what I'd really like to do is stay in my current residence for as long as possible" (AARP, 2010). Two-thirds of participants noted that being near friends or family and being near where one wants to go is *extremely* or *very important* to them (AARP, 2010). Additionally aspects of one's community continue to be a motivating factor for aging in place, as two-thirds of respondents want to stay in their home because they like what their community has to offer them (AARP, 2010). These responses show that a large majority of older adults want to stay in their home as long as possible.

Balance difficulty and high fall risk is one important reason why elders cannot safely remain living independently in their homes. One effective way to keep more seniors independent at home is to provide balance and fall prevention training. Fall prevention training helps seniors learn how to respond to different situations where falls could occur (i.e. icy sidewalks). In addition, education about home modifications can reduce fall risk. Home modification such as replacing outside stairs with a ramp,

installing handrails, and installing bathroom grab bars, can help seniors live more safely and independently in their homes (AARP Public Policy Institute, 2010).

Improving Balance and Reducing Fall Risk through Exercise

Impairments in muscles strength, reaction time, vision, cognition, gait, and balance increase the risk of falls for the elderly population (Karinkanta, Piirtola, Sievänen, Uusi-Rasi, & Kannus, 2010; Lord et al., 2005). It has been shown that physical activity and exercise improve balance and reduce the risk of falls (Costello & Edelstein, 2008; Belza et al., 2006). Specifically, programs with a strong balance component that includes a challenging component such as practice of reactive recovering from change-in-support reactions, recovery during self-initiated movements and practice with narrowing or different bases of support, are especially effective (Gillepsie et al., 2009; Maki et al. 2008; Sherrington et al. 2008). Also, multifactorial exercise programs, in a group or individual format, incorporating at least two different types of exercise, either strength, balance, or endurance, held three times per week for 30 minute sessions over a minimum of 12 weeks are effective (Karinkanta et al., 2010; Costello & Edelstein, 2008; Zijlstra et al., 2007). Strengthening exercises are not effective in preventing falls on their own but are an important component of a multifactorial program (Karinkanta et al., 2010). Exercises can be diverse but usually target specific muscle groups and vary the frequency, intensity and progression of the exercises with the thought that increasing muscle mass and strength of weak muscles will help to improve balance (Costello & Edelstein, 2008; Lord et al., 2005). Walking, treadmill walking, and stationary bicycles

with levels monitored using target heart rates are typically used to increase endurance and aerobic capacity (Costello & Edelstein, 2008).

Tai Chi, an ancient Chinese martial art, consisting of slow rhythmic and precise movements while maintaining a concentrated mind has been found to positively affect participants' "balance, mental outlook, and stress" (Sattin, Easley, Wolf, Chen & Cutner, 2005). Movements emphasize weight shifting, coordination, trunk rotation, and the gradual narrowing of the lower extremity stance (Sattin, et al., 2005). Following a weekly tai chi group (n=30) over a six-month period, with a 3-week learning period, fear of falling during daily activities was significantly decreased in the older female with osteoarthritis population (Song, Roberts, Lee, Lam, & Bae, 2010). Sattin, et al. (2005), investigated the effects of an intense tai chi exercise program versus a wellness education program on decreasing fear of falling. Intense tai chi was defined at two sessions per week at increasing duration starting at 60 minutes and increasing to 90 minutes over a period of 48 weeks (Sattin, et al., 2005). Results showed a significant reduction ($P < .001$) in fear of falling for the tai chi group after 12 months of intervention. Tai Chi has also been shown to improve performance on functional balance measures (Li et al. 2005)

Matter of Balance

The aim of the Matter of Balance program is to reduce fear of falling in older individuals, stop the fear of falling cycle, increase activity levels, and address attitudes and beliefs about falls (Peterson, 2003; Partnership for Healthy Aging, n.d.). The program is a standardized set of educational instruction and exercise that is run with two

2-hour group sessions per week for 9 weeks, although there is some flexibility to vary the program delivery. Numerous studies have demonstrated positive effects of the MOB intervention on participants' self-reported activity levels, balance confidence, and self-efficacy for fall prevention (Ory et al., 2010; Beling & Roller, 2009; Zijlstra, van Haastregt, van Eijk, & Kempen, 2006; Tennstedt et al., 1998). Matter of Balance sessions are typically lead by a trained facilitator who is a health care professional, volunteer lay leader, or community member/non-health care professional. A discussion portion of the program uses cognitive restructuring techniques to change negative beliefs into more adaptive ones (Peterson, 2003). For example changing the thought of “I am too old. If I engage in exercise I will injury myself” into “With guidance and some adaptations I can safely participate in exercise regardless of my age” (Peterson, 2003). Throughout the program, participants’ concerns about falls are acknowledged and recognized as a rational response to the threat falls pose to older adults (Peterson, 2003).

A randomized trial completed by Tennstedt et al. (1998) and then repeated by Zijlstra et al. (2006), showed that the Matter of Balance program increased fall self-efficacy, which is the confidence a person has in performing common tasks without falling, and activity levels in community-dwelling adults who have restricted activity due to fear of falling (Peterson & Clemson, 2008).

Beling and Roller, (2009) measured the effectiveness of the Matter of Balance program on muscle strength, gait, balance and fall risk among community-dwelling elders. Those in the experimental group (n=12) attended Matter of Balance class 3 times a week for 1 hour over a period of 12 weeks, with participants required to attend a

minimum of 30 sessions. The intervention consisted of exercises from the exercise portion of the Matter of Balance program and additional activities that challenged and trained balance. The additional activities worked on balance with a decreasing base of support, weight shifting, forward reaching, and challenges to dynamic visual acuity. The MOB exercises and additional balance exercises were conducted in a large group format. These large-group activities were followed by smaller group station activities and concluded with a large group repeated sit-to-stand exercises while holding onto a therapy ball, of which size and weight increased as performance improved. The smaller group station activities were done in addition to the standard Matter of Balance exercises. Results on the Berg Balance Scale showed improvements over time for the experimental group (from 48.1 to 52.9 out of 56) and decreases for the control group (from 49.1 to 47.8 out of 56) (Beling & Roller, 2009). Although this study had a small sample size, those participating experienced a decreased fall risk and improved functional balance ($p \leq 0.05$), which could be generalized to other community dwelling elders.

Wii Fit

The Nintendo Wii Fit is an interactive video exercise game that has shown promise for improving balance in the elderly (Nitz, Kuys, Isles, & Fu, 2010; Hermes, Hitch, Honea, Stephenson, & Bauer, 2010; Bomberger, et al., 2010). The Wii Fit is structured as a series of games, intended to be fun and motivating. The Wii Fit software provides a number of 'fun' games that feature balance training, yoga (body alignment and controlled movements), strength training, and aerobic, games. In addition to being fun,

the Wii Fit also provides the participant with immediate feedback about the movements of the body's center of gravity, a key measure of balance control. All exercises are performed on the Wii Balance Board, which has pressure sensors that can measure a user's center of balance and weight. A video monitor displays visual feedback about the approximate location of the body's center of pressure with respect to their base of support, i.e. foot location. The participant receives online feedback about how much and in what direction they are swaying or leaning while they perform balance exercises. Studies using instrumented force plates, which are costly, suggest visual feedback on postural control can be used to predict fall risk in both those with and without balance problems (Pajala et al., 2007; Piirtola & Era, 2006). The Wii fit board is a low-cost alternative to an instrumented force plate and Clark et al. (2010) showed that the Wii balance board is an adequate tool to measure standing balance through center of pressure location.

Several recent studies, all with small sample sizes, suggest exercise with the Wii Fit improves balance. Nitz et al. (2010) conducted a study with 10 healthy women, 30-58 years using Wii Fit. Intervention consisted of 30 minute sessions twice weekly for 10 weeks. Participants followed a Wii Fit regime consisting of balance games, yoga, aerobic, and strength activities. Results showed a significant improvement ($p < 0.05$) in balance and lower limb strength. However, reaction times and flexibility did not improve. The sample size of the study was relatively small, with only three participants completing all Wii Fit sessions.

A study conducted by Hermes et al. (2010), compared the use of Wii Fit (n=4) versus traditional exercise (n=4) versus no exercise (n=4). Intervention occurred over a period of eight weeks, with four participants in each group. Wii Fit sessions were offered at a senior center twice a week for 40 minutes. Sessions included flexibility, balance, strength training, and cardio exercises all using the Wii Fit program and balance board. Participants in the traditional exercise group attended traditional group exercise classes (traditional exercise was not defined). The Wii group showed large changes in their balance when compared to the traditional exercise group and control group. However, the traditional exercise group showed greater changes in functional fitness (chair stand, arm curl, and 12 minute walk). Results show that Wii Fit instead of traditional exercise could be used as an effective tool for improving balance although it needs to be studied further with a larger sample size.

Bomberger, et al. (2010) compared the effects of Wii Fit on normal elderly (NE) and elderly with mild to moderate balance concerns (MC). Eight participants in the NE group completed four weeks of Wii Fit training for 20-minute sessions three times per week on non-consecutive days for a total of 240 minutes measured using a stopwatch. Six participants in the MC group completed six weeks of Wii Fit training for a total of 360 minutes measured using a stopwatch. All sessions began with three poses from the yoga section and concluded with balance games. Results from the Berg Balance Scale showed a 3.84% increase for the NE group and a 0.41% increase for the MC group. The Tinetti Gait and Balance Assessment showed a total score increase of 1.80% and gait increase of 5.35% for the NE group and a 0.76% total score increase for the MC group. These results

show that Wii Fit training can be an effective tool to improve balance in the typical elder population who do not present with balance concerns.

Part of why the Wii Fit may be effective in improving balance is that it may be more enjoyable and motivating than traditional exercise. Older adults enjoyed participating in Wii Fit over traditional treadmill walking and jogging (Graves, et al., 2010). Greater improvements will be seen in those who continue to participate in exercise or balance training and enjoyment is a determinant, which will influence continued engagement. Although promising, there is no evidence to date about whether older people exercise more consistently when using the Wii Fit versus other exercise approaches.

Although all the previously described research studies showed some improvement in participants' balance when using the Wii Fit, changes were small and no evidence was provided about whether changes made an impact at the functional level and whether changes were maintained after the intervention ceased. Small sample sizes decreased the studies' power and decreased their ability to generalize to the community dwelling elder population at large. However, results are promising and justify further research with larger sample sizes.

Improving Overall Quality of Life Through Exercise

Quality of life is a very broad concept that looks at areas such as physical, psychological, and social wellbeing (Katula, Rejeski, & Marsh, 2008; Lin, Wolf, Hwang, Gong, & Chen, 2007). Quality of life measures can provide a comprehensive profile of an individual. Fall prevention programs affect fall risk as well as other aspects of health in a

person's life. It could be hypothesized that improving an individual's health through exercise will improve their overall wellbeing.

A research study conducted by Lin et al. (2007) compared the effects of three different interventions, including exercise training, on improving quality of life, functional balance and gait, activities of daily living, fear of falling, and depression in adults aged 65 and older who had recently experienced a fall. The exercise portion of this intervention focused on stretching, muscle strengthening, and balance training. Each session lasted 40 to 60 minutes over a period of 4 months. Results showed that the exercise training group improved quality of life. In comparison to the falls prevention education group the exercise training group scored 2.1 points higher in the physical domain, 3.8 points higher in the psychological domain, 3.4 points higher on the social domain, and 3.2 points higher in the environmental domain on the World Health Organization Quality of Life instrument (Lin et al., 2007).

Katula et al. (2008) compared the effects of progressive resistance strength training (ST) and high velocity power training (PT) on improving measures of quality of life in older adults. Over a period of 12 weeks, participants in the ST and PT groups completed three training sessions per week, with the focus of the intervention on lower body exercises using both Nautilus machines and dumbbells (Katula, et al., 2008). Participants completed the Self-Efficacy for Strength (SE), the Satisfaction with Physical Function (SPF), and The Satisfaction With Life Scale (SWL). Results showed that the PT group showed more significant change in SE, SPF, and SWL than the control group and the ST group showed greater change in SE than the control group (Katula et al., 2008).

These results show that PT may affect more levels of quality of life for the older adult, although more evidence is needed.

Balance Assessments

Several clinical assessment tools have been developed to quantify an individual's balance control (Perell et al. 2001). The Berg Balance Scale and the Tinetti Gait and Balance Assessment are among the most widely used tools for quantifying balance and fall risk in older individuals (Yelnik & Bonan, 2008).

The Berg Balance Scale (Berg, Maki, Williams, Holliday, & Wood-Dauphinee, 1992) evaluates a client's performance on 14 items common in daily life (Mathiowetz & Bass-Haugen, 2008). Numerous studies have found that the Berg Balance Scale (Berg, et al., 1992) is reliable and valid for identifying and evaluating balance impairment in older adults (Blum & Korner-Bitensky, 2008; Whitney, Poole, & Cass, 1998; Berg, Wood-Dauphinee, & Williams, 1995). The Berg's items test the client's ability to maintain balance in positions of increasing difficulty with a decreased base of support and the test takes approximately 20-30 minutes to administer (Berg et al., 1992). The 14 test items are scored on a 0-4 scale with a possible score of 0 to 56. Strengths of this assessment include the varying aspects of balance assessed, its reliability and evidence of validity (Mathiowetz & Bass-Haugen, 2008).

The Tinetti Gait and Balance Assessment (Tinetti, 1986) was designed to assess balance and gait in community dwelling elders. The Tinetti has been shown to be highly reliable and to be valid for adults over the age of 65 (Yelnik & Bonan, 2008; Whitney,

Poole, & Cass, 1998; Tinetti & Ginter, 1988; Tinetti, Speechly, & Ginter, 1988). The balance component consists of 13 items including sitting balance, standing balance, unilateral stance, bending down and picking up an object, and sitting down (Tinetti, 1986). The gait component consists of nine items including initiation of gait, step height and length, step symmetry, trunk stability, and walking stance (Tinetti, 1986).

These two balance assessments were chosen for this study because: (1) there is strong evidence showing their reliability and their validity to measure balance and predict fall risk in older individual (2) they have been widely used in research to study the effectiveness of fall intervention programs and (3) they can be easily generalized to the everyday activities in which people engage.

Purpose of Study

Preventing falls as people age is an important public health issue and an important part of maintaining activity levels and quality of life. Several systematic reviews identified balance exercises as one of the critical components of effective fall prevention intervention programs (Gillepsie et al., 2009; Maki et al. 2008; Sherrington et al. 2008).

The Wii Fit interactive video game is a new tool that shows promise for improving balance and reducing fall risk in older individuals. The Wii Fit is widely available commercially, is relatively user friendly, and can be independently used by an elderly population, thus would be a low-cost way for improving balance. The Wii is also structured as a game and designed to be fun and motivating, which means that people might exercise more frequently and consistently than they would with more traditional

exercise programs. However, there is very little evidence on whether exercises with the Wii Fit are feasible and improve balance in older individuals. This study was conducted in community dwelling elders to determine whether: (1) balance improves after a 3-week period of exercising with the Wii Fit, (2) balance improves more with the Wii Fit as compared to MOB exercises, which are not structured as games and do not provide video feedback to the participant about their movements, and (3) the Wii Fit activities are enjoyable. In addition to effects on balance, we investigated whether participation in the Wii exercise intervention program improved perception of health and well-being.

Hypotheses

This research study compares two different exercise programs for improving balance: Matter of Balance and Wii Fit exercises. The study's hypotheses are:

1. Participants in the Wii Fit Group and MOB group will significantly improve in balance as measured by the Berg Balance Scale and the Tinetti Gait and Balance Assessment.
2. Participants in the Wii Fit Group and MOB group will significantly improve in health and wellness as measured by the SF-36.
3. Participants in the Wii Fit Group will make greater improvements in balance than the Matter of Balance group.

Method

Design of the Study

This randomized group intervention study was structured using a mixed design with one repeated factor (time: pre- and post-intervention) and one between-subject factor (intervention group: Wii Fit, MOB, Control).

Participants

Participants were recruited from the Covenant House, a low-income senior housing facility, in Brighton, MA. All residents of the Covenant House were invited to participate in the study (n=250). Thirty-eight residents were interested in participating and of these, 32 residents (mean age 78.27 ± 6 yrs) completed the study. Boston University Institutional Review Board approval was obtained prior to the initiation of recruitment. Each participant gave informed consent before beginning testing and intervention.

Interested participants were screened for the following inclusion criteria: 1) being over the age of sixty; 2) living independently within the community; 3) having the ability to see the television clearly from 8 to 10 feet away; and 4) having the ability to ambulate independently with or without an assistive device. Participants were excluded if they: 1) had decreased endurance and could not stand long enough to participate in the games (e.g., > 2 minutes); 2) had limited weight bearing capacity on both lower extremities due to pain, injury or weakness; 3) had decreased cognitive ability to follow instructions and grasp the objective of the games; or 4) unable to engage in 10-15 minutes of physical

activity without a break. There was no distinction or particular recruitment of participants based on gender, socioeconomic status, religion, or ethnicity.

The participants were randomly divided into three subject groups. The groups were similar in age, gender, and ethnicity (Table 1).

The three study groups were:

Experimental Group 1—Wii Fit Group: received Wii Fit balance training and completed supplemental home exercises.

Experimental Group 2—Matter of Balance Group: completed exercises from the Matter of Balance Program, administered by the staff exercise physiologist.

Control Group: received no intervention.

Table 1: Participant Demographics

Characteristic	Wii Fit (n=11)	Matter of Balance (n=11)	Control (n=10)
Age (years)	79.8 ± 4.7	77.9 ± 6.9	76.9 ± 6.3
Sex			
Female	9	8	8
Male	2	3	2
Ethnicity			
Russian	7	8	7
Hispanic	1	0	1
Asian	3	3	2

Note: Age is given as Mean ± SD

The age range for participants in the Wii Fit group was 73.9 - 90.9 years. In the Wii Fit Group, one participant ambulated with the assistance of a cane and one participant ambulated with the use of a walker.

The age range for participants in the Matter of Balance Group was 63.2-84.9 years. In the Matter of Balance group, one participant ambulated with the assistance of a cane.

The age range for participants in the Control Group was 63.8-83.2 years. All participants were able to independently ambulate without the use of assistive devices.

Description of Instrumentation

Three outcome measures were administered before and after intervention. The Berg Balance Scale and the Tinetti Gait and Balance Assessment were used to quantify balance performance. The SF-36 was used to quantify health and well-being. All measures were collected on each participant before and following the intervention program.

The Berg Balance Scale. The Berg Balance Scale (Berg, et al., 1992) is a valid instrument for measuring balance in elderly individuals (Appendix A). The scale consists of 14 items that test postural stability, including static and dynamic balance. Items are graded on a scale of 0-4, with a total score ranging from 0 to 56 points. Higher scores reflect better balance. The Berg was selected for use in this study because 1) it is a tool that is commonly used to screen for fall risk and 2) it is a tool that has been widely used to quantify balance in intervention studies aimed at improving balance or reducing fall risk.

The Tinetti Gait and Balance Assessment. The Tinetti Gait and Balance Assessment (Tinetti, 1986) is used to assess mobility, balance, gait, and to predict risk for

falls (Köpke & Meyer, 2006) (Appendix B). The assessment consists of 10 balance items for a total balance score of 16 and 8 gait items for a total gait score of 12 and overall total Tinetti test score of 28. Like the Berg Balance Scale, the Tinetti Assessment was selected as a balance measure because it is widely used to assess fall risk and as an outcome measure to look at the effectiveness of interventions to reduce fall risk.

SF-36 Health Survey. The SF-36 health survey (Kaplan, 2009) consists of 36 questions yielding an 8-scale profile of functional health and well-being scores. Scoring yields an eight-scale profile of the individual's functional health and well-being. Scores range from 0 to 100 and higher scores mean that quality of life is high or not hindered by health issues (Appendix C).

Wii Fit Enjoyment Questionnaire. Participants in the Wii Fit group completed the Wii Fit Enjoyment Questionnaire, a questionnaire developed specifically for this study (Appendix D). Questions were related to enjoyment of the Wii Fit balance games, motivation, interest, and perceived improvement in balance

Wii Fit Program and Balance Board. The Nintendo Wii Fit program and accessory balance board were used with the Wii Fit group. The balance board contains several pressure sensors that enable real-time measurement of the location of the participant's center of pressure (Clark, et al., 2010).

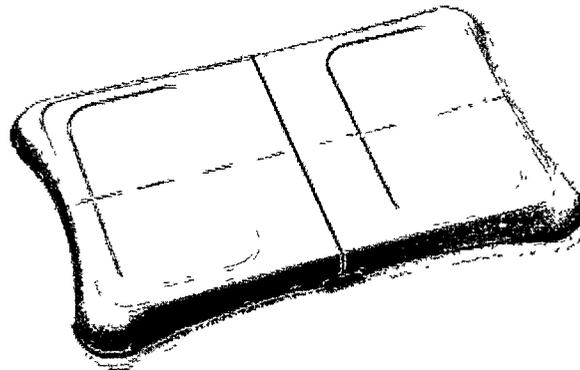


Figure 1. Wii Balance Board (Nintendo, 2011)

Procedure

Initial Meeting and Pre-Testing. Informed consent (Appendix E) was obtained from participants during the recruitment phase. Russian participants were given copies of the consent form in Russian to read, although they signed an English copy. The author and an exercise physiologist from The Covenant House held meetings to inform the residents about the project and to explain procedures and requirements for participation. Participants who signed consent forms were scheduled for pre-testing sessions in either an individual or group session depending on the need for assistance of a translator. Immediately prior to the pre-test evaluation, each participant was again informed of all procedures, their group placement, and the requirements for participation based on their group. Next, the author administered the Berg Balance Scale and Tinetti Gait and Balance Assessment to the participant. The SF-36 and a demographic questionnaire were also completed. Intervention sessions and post-testing schedules were arranged at this time.

Interventions. Interventions varied by group. Participants were randomly assigned to one of three groups using a random number table. Participants in the Wii Fit group received the following interventions over a three-week period: 1) individual Wii Fit training twice a week; and 2) supplemental home exercises. The home exercises included exercises recommended by the National Institute on Aging to improve balance and flexibility (National Institute on Aging, 2010) (Appendix F). The supplemental exercises were included to add a strengthening component to the Wii Fit group's intervention because systematic reviews have shown that multifactorial exercise programs which include balance exercises and strengthening are the most effective types of programs for decreasing fall risk (Costello & Edelstein, 2008). Participants in the Matter of Balance group received the following interventions over a three-week period: 1) group strength/balance training using exercises from the Matter of Balance Program twice a week.

Wii Fit Intervention. Participants in the Wii Fit group met for individual sessions led by the author twice a week for three weeks. Each exercise session totaled 10-15 minutes of total playing time, with an average time of 13 minutes per participant (as tracked by the Wii Fit Bank) excluding rest breaks and instructional trials before each game.

A total of 5 Wii Fit games were introduced to participants across the three-week intervention period and the 5 games were the same for all participants. Participants were encouraged to try each introduced game at least once and then used their own discretion to determine which games to play for the remainder of sessions. Participants

engaged in as many as three to five different games within a session, depending on their self-reported level of fatigue and motivation. The author maintained control over the remote throughout the session to decrease the chance of incorrect button input from participants.

During the first week, participants were introduced to soccer heading, which simulates heading soccer balls in the goalie position; ski jumping, which simulated skiing down a take-off ramp and jumping to attempt to land as far as possible down the hill; and ski slalom, in which participants skied between gates. During the second week, participants were presented with the Wii tightrope game in which they had to maintain balance while walking across a tightrope. During the third week, participants were introduced to table tilt, in which they had to shift their balance to get the marble into the holes and advance to the next level; and the balance bubble, in which participants attempted to navigate down a river in a bubble without bursting it on the sides.

During each of the Wii Fit Sessions, the researcher documented the duration and games chosen. In addition, during the first intervention session, participants completed the Wii Fit Evaluation, which assessed their Body Mass Index (BMI) and Wii Fit Age. All information was kept confidential in a secure coding system.

Supplemental Exercises. Each participant in the Wii Fit group was instructed in a set of supplemental home exercises to be performed daily. First, the researcher gave brief demonstrations of the exercises to ensure that participants understood how to perform the exercise. Next, participants were given a written packet of the home exercises, with instructions written in English and with photographs of each

exercise (Appendix F). Participants were requested to complete each exercise once a day as many days as possible during the intervention period. The instruction packet provided a checklist for participants to track which days they completed each exercise. During the initial exercise instruction session and in each Wii Fit session, participants were given the opportunity to ask additional questions about the exercises. The staff exercise physiologist was also available to complete the exercises with participants. With each progressing week, participants were given a new checklist of exercises and asked to turn in their old checklist. These packets were coded as they were submitted to maintain confidentiality.

Matter of Balance Interventions. Participants in Experimental Group 2 completed the exercise component of the Matter of Balance Program, which was administered by the staff exercise physiologist. Participants attended group exercise sessions totaling 30-45 minutes, twice a week for three weeks. The exercise physiologist followed the *Matter of Balance* exercises exactly as indicated in the manual (Tennstedt et al., 1998). Each Matter of Balance session began with warm-up exercises, followed by strength and balance exercises and concluded with cool-down exercises. A complete list of the *Matter of Balance* exercises can be found in Appendix G. During the first week, participants completed eight repetitions of each exercise. During the second week, participants completed twelve repetitions of each exercise. During the third week, participants completed fifteen repetitions of each exercise. Participants in the MOB were not required to complete the MOB class exercises outside of class.

Post Evaluation. After the three weeks of Wii Fit and Matter of Balance intervention were completed, each participant was re-evaluated by the researcher using the Berg Balance Scale, the Tinetti Gait and Balance Assessment, and SF-36. In addition, the participants in the Wii Fit group completed the Wii Fit Evaluation and an Enjoyment Questionnaire. Each of the forms associated with the assessments were coded to ensure participant confidentiality and all of the data obtained was saved in a password-protected document on a password-protected computer.

Table 2: Intervention Characteristics

	Session Structure	Intervention Frequency	Duration of Exercise	Components of Balance Practiced	Home Program
Wii Fit Group	Individual Sessions	2 sessions per week for 10-15 minutes of active game play	3 weeks	Four-Way Balance and Side to Side Balance	Supplemental home strengthening exercises (~15 minutes) to be completed at least 1 per day
Matter of Balance Group	Group Sessions	2 sessions per week for 30-45 minutes	3 weeks	Four-Way Balance, Side to Side Balance, and Forward Backward Balance	None

Data Analysis

Repeated measures ANOVAs were used to determine whether there was an effect of the interventions on balance and on health and well-being and whether there were any differences between intervention groups. The within-subjects factor was time (pre-post

intervention) and the between-subjects factor was exercise (Wii Fit, MOB, Control). Statistical Programs for the Social Sciences 19 (SPSS) was used for all statistical analyses. One-way ANOVA's were also performed on pre-test scores to determine whether the groups were similar in balance and health and well being at baseline, prior to beginning the intervention programs. Results were considered significant when $p < 0.05$. Descriptive, homogeneity of variance test, and Welch statistics were also analyzed.

Results

Time Spent in Intervention

There was a 100% attendance rate for all participants in both the Wii Fit group and MOB group. On average, participants in the Wii group played for 13.34 minutes each session according to data from the Wii Fit's log. This is a shorter duration than the 30-45 minutes sessions of the MOB participants. However, the Wii Fit group was also instructed in a supplemental set of daily exercises (15 minutes per session) that made the duration of exercise per week more similar between the Wii Fit and MOB groups. According to self-reported exercise logs, only 8 out of the 11 participants in the Wii Fit group completed the exercises. Of these 8 only 6 participants reported daily completion of the exercises and 2 participants reported completion 5-6 days per week.

Balance Performance

The Wii Fit, MOB, and control groups were similar in their balance performance before the intervention programs began (ANOVA of pre-test Berg Balance Scale: $F_{(2,29)} = 0.257, p = 0.775$; ANOVA of the Tinetti Gait and Balance Assessment: $F_{(2,29)} = 0.149, p = 0.863$). There was no statistical difference in the amount that the exercise groups improved as compared to the control group, although the actual amounts were greater for the exercise groups.

Balance improved in all three groups after the intervention period (Figures 2 and 3; Table 3). In the repeated measures ANOVA, there was a significant main effect of time (pre- to post-intervention) on balance ($F_{(1,29)} = 17.034, p < 0.001$ for the Berg;

$F_{(1,29)} = 9.715$, $p < 0.004$ for the Tinetti). There were no interactions between time (pre-, post-) and group (Wii Fit, MOB, Control) ($F_{(2,29)} = 1.45$, $p = 0.251$ for the Berg; $F_{(2,29)} = 0.162$, $p = 0.852$ for the Tinetti). The exercise groups improved more in their Berg balance scores than the Control group, however differences were not statistically different. The changes in scores for the Berg Scale were 3.55 ± 5.03 , 3.45 ± 2.50 , and 1.1 ± 2.99 for the Wii Fit, MOB, and Control groups, respectively. Furthermore, at pre-testing, 25% of participants in the Wii Fit group scored 54 or higher out of 56 on the Berg Balance Scale. This improved to 37.5% of participants scoring greater than 54 at post-test. Improvements from pre- to post-intervention for the Tinetti scores were small and similar across groups: Wii Fit improved by 0.91 ± 2.39 points, MOB improved by 1.36 ± 1.69 points and the Control improved by 1.00 ± 1.76 points.

Only one participant in the study used a walker and this subject was in the Wii Fit group. This subject has among the lowest baseline Berg and Tinetti scores. To make sure that this single subject did not have an outlier effect on the overall results, data was re-analyzed with this subject excluded. Excluding the subject from the analysis did not alter the results.

Figure 2. Effects of Intervention on the Berg Balance Scale

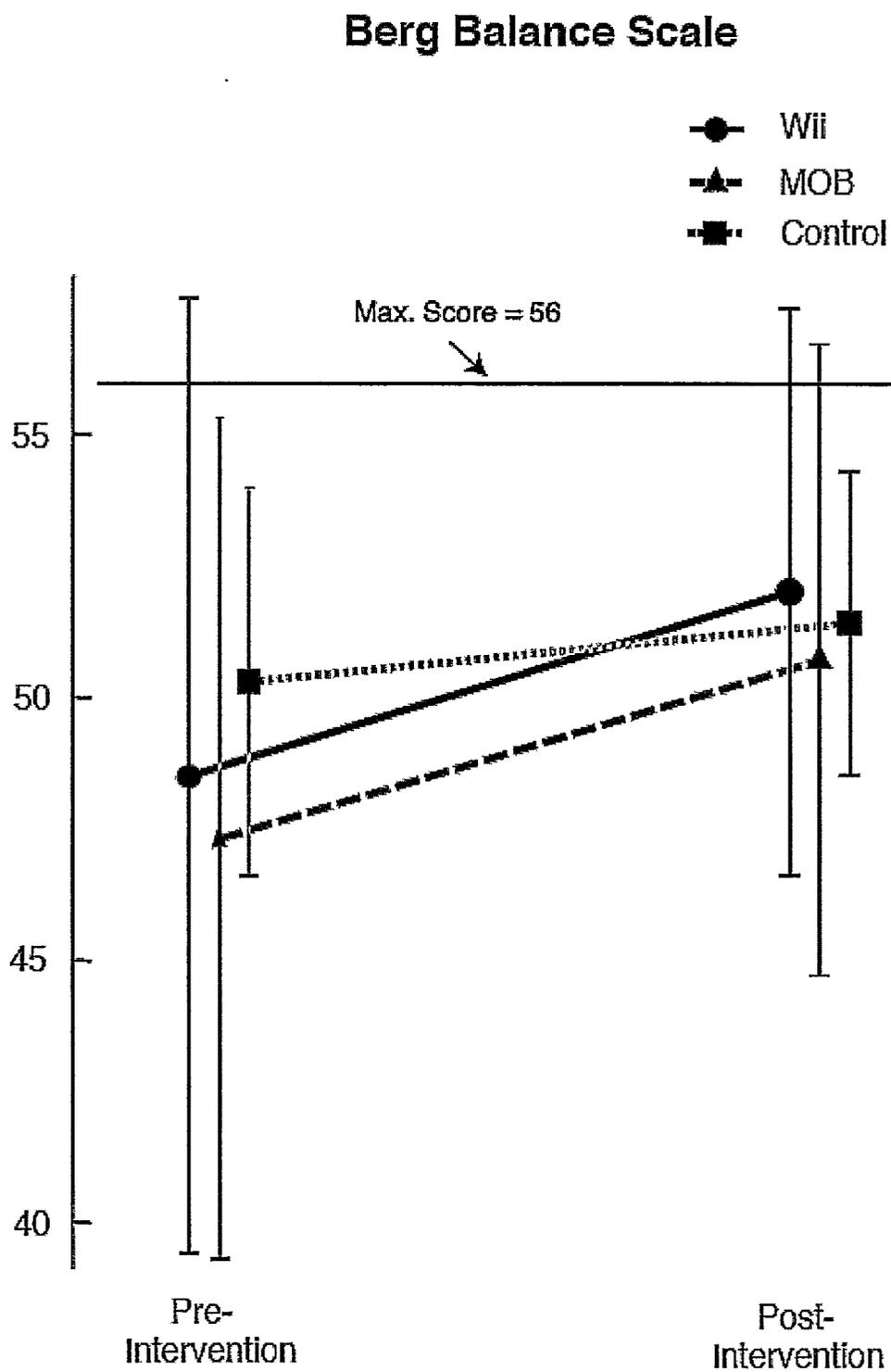


Figure 3. Effects of Intervention on the Tinetti Gait and Balance Assessment

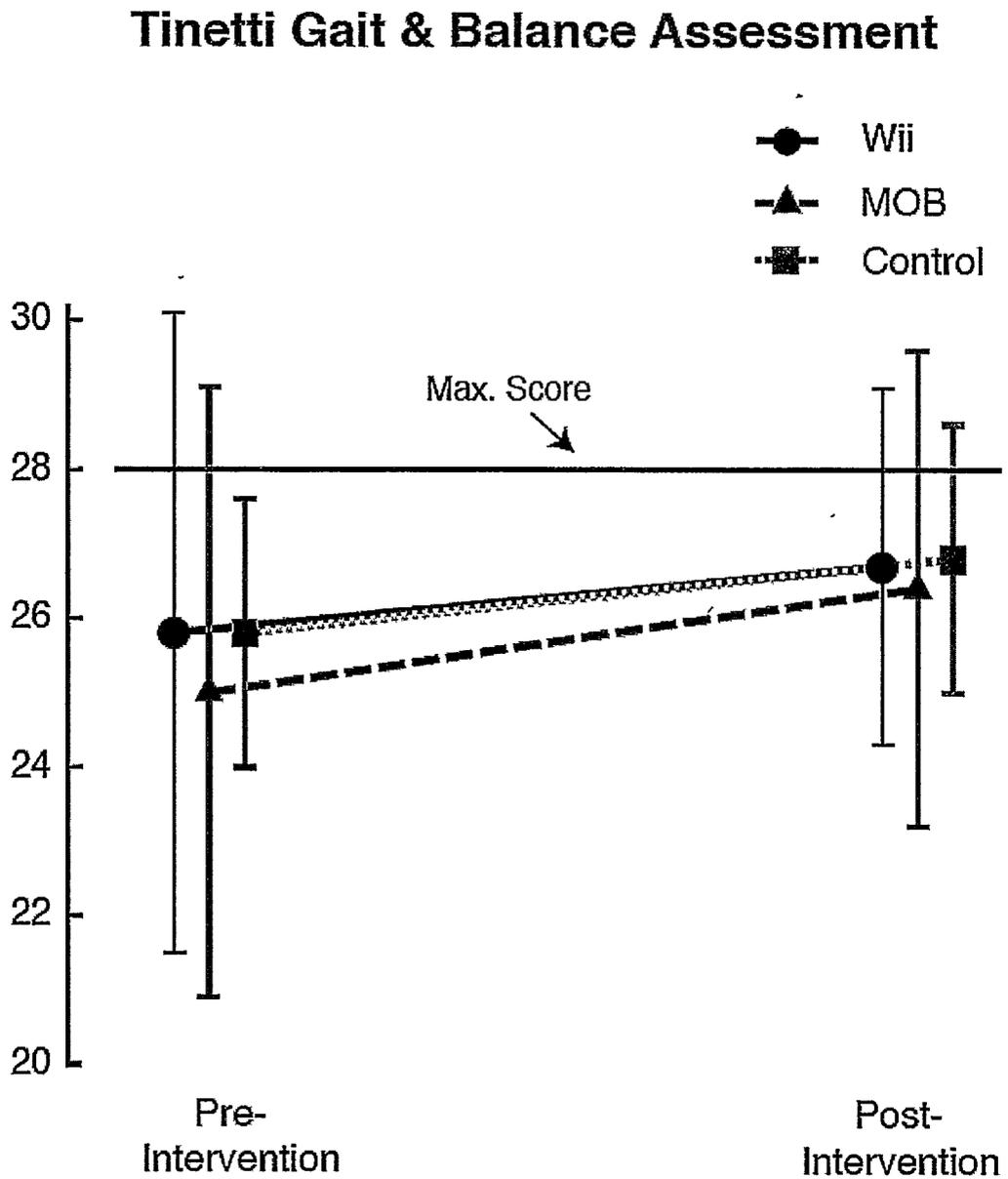


Table 3: Changes in Assessment Scores

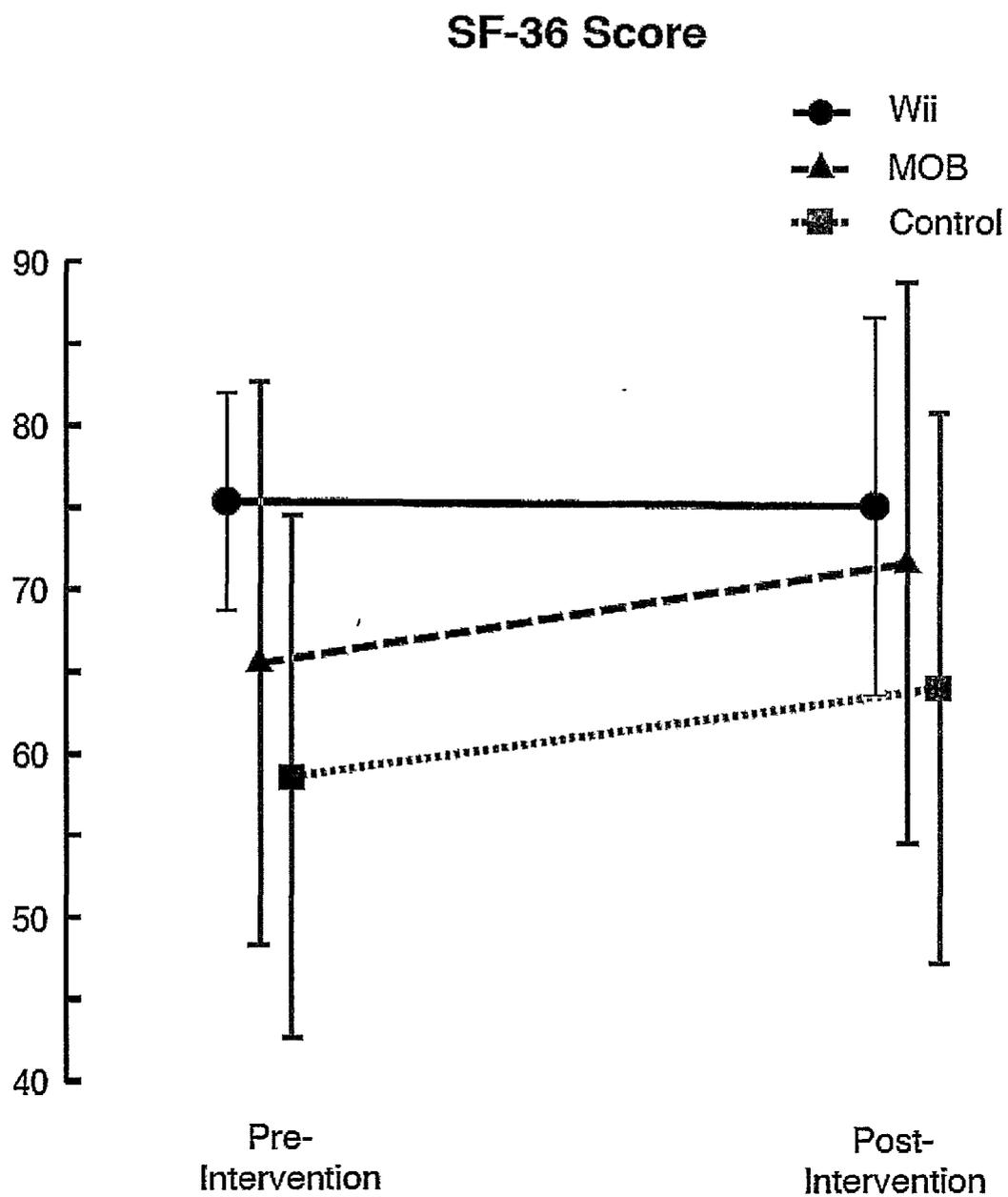
	Wii Fit Group	MOB Group	Control Group
Berg			
Pre-Test	48.5 ± 9.1	47.3 ± 8	50.3 ± 3.7
Post-Test	52 ± 5.4	50.7 ± 6	51.4 ± 2.9
Tinetti			
Pre-Test	25.8 ± 4.3	25 ± 4.1	25.8 ± 1.8
Post-Test	26.7 ± 2.4	26.4 ± 3.2	26.8 ± 1.8
SF-36			
Pre-Test	75.4 ± 6.6	65.5 ± 17.2	58.6 ± 15.9
Post-Test	75.1 ± 11.5	71.6 ± 17.1	64 ± 16.8

Note: Mean ± SD

Health and Well-Being

The groups were different at pre-test in their perception of health and well-being, with differences between SF-36 scores approaching significance ($F_{(2,29)} = 3.154$, $p = 0.058$) (Figure 4, Table 3). The Wii Fit group had higher baseline scores than the MOB and Control groups. At pre-test the mean SF-36 score was 75.4 ± 6.6 for the Wii Fit Group, 65.5 ± 17.2 for the MOB group and 58.6 ± 15.9 for the Control group, all out of a possible 100 point total score. There was no significant change in SF-36 scores from pre- to post-intervention (ANOVA main effect on time: $F_{(1,29)} = 2.095$, $p = 0.159$; non-significant group-time interaction $F_{(2,29)} = 0.624$, $p = 0.543$).

Figure 4. Effects of Intervention on the SF-36



Enjoyment of Wii Fit

Results of the Wii Fit Enjoyment Questionnaire showed that 81% of the participants reported high levels of enjoyment while playing the Wii games. The majority of participants also reported perceived improvements in balance: 18% reported high improvements in their balance and 64% reported moderate improvements in their balance. Participants also identified that they preferred the Wii Fit games to traditional balance exercises: 27% reported they were much better and 55% reported they were better than traditional balance exercises. At post-testing many participants in the Wii Group reported enjoyment in using the Wii and a desire to continue using the games. One participant said "I'm going to ask my children to buy me this (Wii Fit) for my birthday". The interactive component and competitive nature of scoring added elements typically lacking in traditional exercise. At completion of the study all participants were able to use the Wii Fit and it has become a sustainable program at the facility.

Attrition

Fourteen participants in the Wii Fit group, thirteen participants in the MOB group, and nine participants in the Control group entered and completed the pre-test evaluation.

From the Wii Fit group, two participants withdrew from the study following pre-testing citing they no longer had time to complete the training sessions and one participant's data was excluded due to difference in pre-and post-testing conditions, as the pre-test was completed using a walker and post-testing was completed without a walker. Leaving a total of eleven participants

From the MOB group, one participant was moved to the control group, as only pre- and post-test data was obtained and one participant was excluded due to age. The MOB group has a total of eleven participants.

All Wii Fit group participants successfully completed the entire three weeks of training (two sessions per week for three weeks) as well as the pre- and post-testing sessions. Eight participants completed the supplemental home exercises. All MOB participants successfully completed the entire three weeks of training (two sessions per week for three weeks) as well as the pre- and post-testing sessions.

Discussion

The main result of this study is that the Wii Fit exercise program proved to be feasible and enjoyable by a group of community-dwelling elders. The results also suggest that exercises with the Wii Fit may improve balance, however, the improvements in balance were small and not significantly greater than that observed for the control groups. The reason for the small size and non-significance of intervention effects is likely that the intervention period was too brief, only 3-weeks duration, although a number of other limitations may also have influenced the results. There was no effect of intervention on health and well-being as measured by the SF-36, which may be due to language barriers as English was a second language for most participants.

Balance

Following a three-week period, all participants made small, but significant improvements in their balance. Improvements were larger for the exercise than non-exercise groups, an encouraging finding. However, the difference in improvement was non-significant. The reasons why there were not greater improvements in balance with exercise are several, including that (1) the intervention may have been for too brief a period (3 weeks); (2) the balance measures used may have not have been able to capture changes in balance in this relatively high-functioning group; (3) high variability across subjects at baseline and small sample size made it difficult to show statistical differences between groups (4) the Wii Fit video game and all exercise instruction were in English and that is not the native language of any of our participants; (5) age related changes,

such as slower reaction times and altered vision, may have affected success with performing the balance activities in the Wii Fit games (6) lack of compliance with supplemental home exercises for some participants in the Wii Fit group, thus reducing their total exercise time per week.

The short intervention period is the most likely reason why improvements in balance were not greater for the exercise groups. The small increase in balance after exercising with the Wii Fit in this study is in contrast to the findings in other studies that included much longer periods of intervention than the 3 weeks of the present study (10 weeks in Nitz, et al., 2010; 8 weeks in Hermes, et al., 2010; 4 or 6 weeks depending on group in Bomberger, et al., 2010). The 3-week duration of the present study is also much shorter than the Matter of Balance intervention programs that have demonstrated improvements in fall self-efficacy after intervention (Beling & Roller, 2009; Zijlstra et al., 2006; Tennstedt et al., 1998). Multifactorial exercise programs that have been successful in improving balance were conducted over a 12-week period (Costello & Edelstein, 2008). Thus, too brief of an intervention period is the most likely reason why this study did not show greater improvements in balance for the Wii Fit and MOB groups. Interventions that last only three weeks may not be long enough to produce a large change in balance. Since the participants in the exercise groups in this study showed a trend of increased scores in only 3 weeks, it is possible that an additional 3 weeks of intervention would result in changes similar to those reported other studies (Nitz et al. 2010; Hermes et al. 2010; Bomberger et al. 2010).

Of the three Wii Fit studies discussed in this article, we can only directly compare amounts of improvement with intervention to a study by Bomberger et al. (2010), as this is the only other study that used the same balance measures, the Berg Balance Scale and Tinetti Gait and Balance Assessments. The amount of improvement in balance that we observed, after the exercise interventions is comparable, and slightly greater than, Bomberger et al. (2010) (Current study Berg: Wii Fit: 5.03 ± 3.55 ; MOB: 3.45 ± 2.50 ; Control: 1.1 ± 2.99 ; Tinetti: Wii Fit: 2.39 ± 0.91 ; MOB: 1.36 ± 1.69 ; Control: 1 ± 1.76 ; Bomberger et al. Berg: NE: 3.84%; or 2 points MC: 0.41% or 0.84 points; Tinetti: NE: 1.80% or 0.5 points; MC: 0.76% or 0.83 points).

An important question is how much change on the Berg and Tinetti is clinically meaningful, translating to a real increase in balance function. For the Berg Scale, a study by Contrabassoon et al. (2007) suggests that a change of at least 8 points is required to show genuine change. Another study by Donohue and Stokes (2009) found that the amount of change necessary was dependent on baseline scores (4 point change for baseline scores within 45-56, 5 points for baseline scores within 35-44, 7 points for baseline scores within 25-34, and 5 points for baseline scores within 0-24). The improvements for the exercise groups in the present study approaches the 4 point-change mark identified by Donahue and Stokes for subjects with high baseline Berg scores.

Another factor besides short intervention dose that may explain why this study did not shower greater effects of exercise on improving balance is that the measures of balance may not have been difficult enough for our subjects and therefore real improvements in balance may have gone undetected. Participants in this study were all

community dwelling elders who had sufficiently good balance to be able to live independently in their homes. The majority of them scored high at pre-testing. At pre-testing, 25% of participants scored 54 or higher out of 56 on the Berg and 81% scored 24 or higher out of 28 on the Tinetti at pre-testing. Since many of our subjects were already scoring high on both assessments prior to intervention, they had very little room to show change.

It is unlikely that the choice of activities included in the Wii Fit and MOB interventions explain why larger improvements in balance were not observed in this study. The Wii Fit and MOB intervention programs included components shown to be key ingredients of successful programs for improving balance and balance confidence (Karin anta et al., 2010; Gillespie et al., 2009; Sherrington et al., 2008; Zijlstra et al., 2007; Costello & Edelstein, 2008). The reason for lack of significance is more likely due to the duration of intervention (Nitz et al. 2010; Hermes et al. 2010; Bomberger et al. 2010).

The Wii Fit activities challenge balance to a greater extent than the MOB exercises and the Wii system provides participants' with real time feedback about balance performance, therefore, the Wii Fit activities could be more powerful for improving balance than MOB exercises. The results of this study do not support this hypothesis. The Wii Fit and MOB exercise groups made similar amount of improvement in their balance scores. This could be explained by the fact that the Wii Fit group performed only 12 minutes of Wii Fit activities twice weekly and this amount of activity may have been insufficient for producing changes in balance. Other than the brief period of Wii Fit

activity for the Wii Fit group, both the Wii Fit and MOB groups performed strengthening and stretching exercises and exercises for similar total amounts of time per week (Table 2).

Health and Well-Being

There were no significant changes in health and well being after either intervention program. It is not clear whether this is due to true lack of change in health and well being or whether it is due to limitations in the ability of the SF-36 to quantify health and well being in our study participants. Wording of questions in the SF-36 were confusing for participants. Although translators were used during the pre- and post-testing sessions, it is not clear that participants understood each question well enough to accurately report self-assessment of their health and well-being. Because of the language barrier, the SF-36 was likely not a good indicator of change in quality of life.

In addition to possible problems with the effect of language challenges on the SF-36 results, it may be that there really was no change in perception health and well-being. Like for the lack of change in balance, it may have been that 3 weeks is too short of an intervention period to have a measurable and meaningful impact on perception of health. In addition, we did not provide education or self-efficacy training like other programs that have utilized the Matter of Balance Intervention Program (Tennstedt et al., 1998) and it may be that this is a critical component for affecting perceptions of health.

Enjoyment of Wii Fit

The Wii games were a fun and motivating way for participants to carry out a balance exercise program, showing that the Wii is potentially a good way to engage older individuals in activities to work on their balance. The majority of participants reported enjoyment of Wii Fit and a preference for Wii Fit based exercise to traditional exercise. The enjoyment and motivation to engage in Wii Fit exercises is similar to that reported in another study (Graves et al., 2010). Finding that the Wii is enjoyable is an important finding, as enjoyment might result in continued use of the Wii Fit. Sustained use of Wii Fit over time could produce and then help maintain improvements in balance confidence, activity levels, and overall perception of well-being.

Summary of Limitations of the Study

Intervention Dose. Intervention only lasted three weeks. Participants might have seen greater improvements if the intervention lasted for a longer period of time.

Balance Measures. At pre-testing, 25% of participants' scored 54 or higher out of 56 on the Berg Balance Scale and 81% scored 24 or higher out of 28 on the Tinetti Gait and Balance Assessment at pre-testing. The Berg and Tinetti may not have been sensitive enough to detect improvement in balance in this elder population who had relatively good functional balance and relatively low fall risk.

Language. English was not the first language for any of the participants and knowledge of English ranged from fluent to no understanding. Translators were used during the pre- and post-testing sessions to help with explaining instructions for

assessments and to help fill out the SF-36. Some participants reported that the English terminology in the SF-36 and the Wii Fit game instructions were confusing. The researcher was unable to fully communicate verbally with some participants and in many cases relied on the use of modeling and other forms of non-verbal communication.

Availability. Due to participant availability, not all intervention sessions could be scheduled on non-consecutive days and some participants completed their two sessions on consecutive days.

Compliance. Compliance with supplemental exercises was difficult to obtain. Three participants failed to complete any of the home exercises. The researcher had to trust that participants were honest in their self-reporting of exercise completion. It was impossible to tell if improvements were due to the Wii Fit balance games, the home exercises, or the combination of the two.

Age Related Issues. There are some age-related issues noticed by the researcher that may have affected the participant's success in the Wii games. Issues noticed included: delayed reaction times, visual perception issues (i.e. in soccer heading would not hold position long enough or lean far enough to make contact with the ball), confusion with vague game instructions (participants wanted more concrete instructions and were unable to understand that there was more than one way to play and be successful in the game), and confusion with the Mii character. The Mii character is a visual representation of the player on the screen as it replicates the movements the player is doing on the screen. Many did not realize that the Mii character shows what they are doing. Lastly, it is important to note that the Wii Fit game was not created for the 60 and

older population. It is suggested that any exercise games created for this population incorporate age-related changes that occur.

Differences at Baseline. The Wii Fit Group and the Control Group were different but not significantly so on scores obtained on the SF-36 at baseline. At pre-test the mean score for the Wii Fit Group was 75.4 ± 6.6 compared to the Control Group 58.6 ± 15.9 . This difference means that the groups were slightly different at the start of the study, which could attribute to the lack of exercises' effect on the SF-36 scores. If the groups had been equal at the start we would have expected scores to remain the same for the Control Group at post-test but to increase for the Wii Fit Group as the engagement in physical activity through use of Wii Fit should lead to improved perception of health and well-being and therefore, an increase in SF-36 scores.

Blinding and Potential Bias. The primary author administered the balance measures, supervised the Wii Fit group, and analyzed the results for all three experimental groups. Thus, there is potential for bias due to lack of blinding of participant's group placement. However, since no differences were found across groups and the measures employed were quantitative, objective, reliable measurement tools, it is unlikely that such bias influenced the results in this study.

Future Research

The biggest limitation in our study may have been the intervention dose. The length of intervention in future studies should be increased to a minimum of six weeks and increase the time spent on the Wii within a session from 10-15 minutes to a minimum

of 20-30 minutes. Previous research studies conducted that have produced statistically significant results have had interventions lasting for a minimum of six weeks (Nitz et al., 2010; Hermes et al., 2010; Bomberger et al., 2010).

In addition to the increase in intervention length, an increase in number of participants as well as the use of assessments with higher ceilings and that are more sensitive to change for those in the well elderly population may have produced more significant results. It would be best to target those with low scores on the Berg or use a different assessment. Anecdotal observations during the course of study showed that some aspects of the Wii games were difficult for participants and suggest a need for the creation of games, or components of games, that are more tailored to the changing health needs of aging individuals in the 60 and older population (e.g. altered vision, slowed reaction time). Game features tailored for the aging population could take into account difference in individual participants' current balance ability, reaction times and visual perceptual difficulties. In addition, more specific written and visual instructions would likely decrease the confusion with game play that many of our participants reported.

For those where English is a second language intervention needs to be adapted to account for the language difference. It would be best to have a gaming system with multiple language options such as Russian and Chinese, in addition to the Spanish and French options that are already standard. When alternative language options are not available, as was the case with this study, the research needs to be able to physically model the gaming actions and exercises and require the participant to demonstrate understanding.

Conclusion

This repeated measures intervention study demonstrated that Wii Fit games are an enjoyable form of exercise as shared through self-report by an elderly population. Wii Fit balance games promoted sustained exercise participation among participants, since participants in the study continue to voluntarily use it as an activity; it has become a sustainable program.

The Wii Fit and the Matter of Balance interventions produced small improvements in balance. The intervention duration may have been too short to see large changes in balance control that would need to occur to affect the balance outcome measures used in this study. Future studies should increase the duration of intervention. Based on a review of the literature it may be more feasible to conduct a study for four weeks or greater (Nitz, et al., 2010; Hermes, et al., 2010; Bomberger, et al., 2010).

Summary

This paper addressed the issue of falls in the elderly population. The study examined the use of Wii Fit versus the Matter of Balance Program at improving balance in those 60 years and older and included a control group who received no intervention.

Thirty-two older adults living independently in the community completed this study. Participants in the Wii Fit group reported enjoyment of their Wii Fit balance activities. For all groups, balance was improved at the end of the three-week intervention period. The exercise groups showed greater improvements than the Control group on balance measures; however, the difference between the groups was not significant. The most likely reason why the improvements in balance were not larger is that the duration of the intervention was only three-weeks. This period may not have been long enough to result in measurable changes in balance and perceptions of health and well-being. It is suggested that additional studies be conducted with an increased intervention period.

Appendix A

Berg Balance Scale

Berg Balance Scale

The Berg Balance Scale (BBS) was developed to measure balance among older people with impairment in balance function by assessing the performance of functional tasks (Berg et al., 1992). It is a valid instrument used for evaluation of the effectiveness of interventions and for quantitative descriptions of function in clinical practice and research (Blum & Korner-Bitensky, 2008; Whitney et al., 1998; Berg et al., 1995). The BBS has been evaluated in several reliability studies. A recent study of the BBS, which was completed in Finland, indicates that a change of eight (8) BBS points is required to reveal a genuine change in function between two assessments among older people who are dependent in ADL and living in residential care facilities.

Description: 14-item scale designed to measure balance of the older adult in a clinical setting.

Equipment needed: Ruler, two standard chairs (one with arm rests, one without), footstool or step, stopwatch or wristwatch, 15 ft walkway

Completion:

Time: 15-20 minutes

Scoring: A five-point scale, ranging from 0-4. "0" indicates the lowest level of function and "4" the highest level of function. Total Score = 56

Interpretation (Berg et al., 1992):

41-56 = low fall risk

21-40 = medium fall risk

0-20 = high fall risk

A change of 8 points is required to reveal a genuine change in function between 2 assessments (Conradsson et al., 2007).

Berg Balance Scale

Name: _____ Date: _____

Location: _____ Rater: _____

ITEM DESCRIPTION	SCORE (0-4)
Sitting to standing	_____
Standing unsupported	_____
Sitting unsupported	_____
Standing to sitting	_____
Transfers	_____
Standing with eyes closed	_____
Standing with feet together	_____
Reaching forward with outstretched arm	_____
Retrieving object from floor	_____
Turning to look behind	_____
Turning 360 degrees	_____
Placing alternate foot on stool	_____
Standing with one foot in front	_____
Standing on one foot	_____
Total	_____

GENERAL INSTRUCTIONS

Please document each task and/or give instructions as written. When scoring, please record the lowest response category that applies for each item.

In most items, the participant is asked to maintain a given position for a specific time. Progressively more points are deducted if:

- The time or distance requirements are not met
- The participant's performance warrants supervision
- The participant touches an external support or receives assistance from the examiner

Participant should understand that they must maintain their balance while attempting the tasks. The choices of which leg to stand on or how far to reach are left to the participant. Poor judgment will adversely influence the performance and the scoring.

Equipment required for testing is a stopwatch or watch with a second hand, and a ruler or other indicator of 2, 5, and 10 inches. Chairs used during testing should be a reasonable height. Either a step or a stool of average step height may be used for item # 12.

Berg Balance Scale

SITTING TO STANDING

INSTRUCTIONS: Please stand up. Try not to use your hand for support.

- 4 able to stand without using hands and stabilize independently
- 3 able to stand independently using hands
- 2 able to stand using hands after several tries
- 1 needs minimal aid to stand or stabilize
- 0 needs moderate or maximal assist to stand

STANDING UNSUPPORTED

INSTRUCTIONS: Please stand for two minutes without holding on.

- 4 able to stand safely for 2 minutes
- 3 able to stand 2 minutes with supervision
- 2 able to stand 30 seconds unsupported
- 1 needs several tries to stand 30 seconds unsupported
- 0 unable to stand 30 seconds unsupported

If a participant is able to stand 2 minutes unsupported, score full points for sitting unsupported. Proceed to item #4.

SITTING WITH BACK UNSUPPORTED BUT FEET SUPPORTED ON FLOOR OR ON A STOOL

INSTRUCTIONS: Please sit with arms folded for 2 minutes.

- 4 able to sit safely and securely for 2 minutes
- 3 able to sit 2 minutes under supervision
- 2 able to sit 30 seconds
- 1 able to sit 10 seconds
- 0 unable to sit without support 10 seconds

STANDING TO SITTING

INSTRUCTIONS: Please sit down.

- 4 sits safely with minimal use of hands
- 3 controls descent by using hands
- 2 uses back of legs against chair to control descent
- 1 sits independently but has uncontrolled descent
- 0 needs assist to sit

TRANSFERS

INSTRUCTIONS: Arrange chair(s) for pivot transfer. Ask participant to transfer one way toward a seat with armrests and one way toward a seat without armrests. You may use two chairs (one with and one without armrests) or a bed and a chair.

- 4 able to transfer safely with minor use of hands
- 3 able to transfer safely definite need of hands
- 2 able to transfer with verbal cuing and/or supervision
- 1 needs one person to assist
- 0 needs two people to assist or supervise to be safe

STANDING UNSUPPORTED WITH EYES CLOSED

INSTRUCTIONS: Please close your eyes and stand still for 10 seconds.

- 4 able to stand 10 seconds safely
- 3 able to stand 10 seconds with supervision
- 2 able to stand 3 seconds
- 1 unable to keep eyes closed 3 seconds but stays safely
- 0 needs help to keep from falling

STANDING UNSUPPORTED WITH FEET TOGETHER

INSTRUCTIONS: Place your feet together and stand without holding on.

- 4 able to place feet together independently and stand 1 minute safely
- 3 able to place feet together independently and stand 1 minute with supervision
- 2 able to place feet together independently but unable to hold for 30 seconds
- 1 needs help to attain position but able to stand 15 seconds feet together
- 0 needs help to attain position and unable to hold for 15 seconds

REACHING FORWARD WITH OUTSTRETCHED ARM WHILE STANDING

INSTRUCTIONS: Lift arm to 90 degrees. Stretch out your fingers and reach forward as far as you can. (Examiner places a ruler at the end of fingertips when arm is at 90 degrees. Fingers should not touch the ruler while reaching forward. The recorded measure is the distance forward that the fingers reach while the participant is in the most forward lean position. When possible, ask participant to use both arms when reaching to avoid rotation of the trunk.)

- 4 can reach forward confidently 25 cm (10 inches)
- 3 can reach forward 12 cm (5 inches)
- 2 can reach forward 5 cm (2 inches)
- 1 reaches forward but needs supervision
- 0 loses balance while trying/requires external support

PICK UP OBJECT FROM THE FLOOR FROM A STANDING POSITION

INSTRUCTIONS: Pick up the shoe/slipper, which is in front of your feet.

- 4 able to pick up slipper safely and easily
- 3 able to pick up slipper but needs supervision
- 2 unable to pick up but reaches 2-5 cm(1-2 inches) from slipper and keeps balance independently
- 1 unable to pick up and needs supervision while trying
- 0 unable to try/needs assist to keep from losing balance or falling

TURNING TO LOOK BEHIND OVER LEFT AND RIGHT SHOULDERS WHILE STANDING

INSTRUCTIONS: Turn to look directly behind you over toward the left shoulder. Repeat to the right. (Examiner may pick an object to look at directly behind the participant to encourage a better twist turn.)

- 4 looks behind from both sides and weight shifts well
- 3 looks behind one side only other side shows less weight shift
- 2 turns sideways only but maintains balance
- 1 needs supervision when turning
- 0 needs assist to keep from losing balance or falling

TURN 360 DEGREES

INSTRUCTIONS: Turn completely around in a full circle. Pause. Then turn a full circle in the other direction.

- 4 able to turn 360 degrees safely in 4 seconds or less
- 3 able to turn 360 degrees safely one side only 4 seconds or less
- 2 able to turn 360 degrees safely but slowly
- 1 needs close supervision or verbal cuing
- 0 needs assistance while turning

PLACE ALTERNATE FOOT ON STEP OR STOOL WHILE STANDING UNSUPPORTED

INSTRUCTIONS: Place each foot alternately on the step/stool. Continue until each foot has touched the step/stool four times.

- 4 able to stand independently and safely and complete 8 steps in 20 seconds
- 3 able to stand independently and complete 8 steps in > 20 seconds
- 2 able to complete 4 steps without aid with supervision
- 1 able to complete > 2 steps needs minimal assist
- 0 needs assistance to keep from falling/unable to try

STANDING UNSUPPORTED ONE FOOT IN FRONT

INSTRUCTIONS: (DEMONSTRATE TO PARTICIPANT) Place one foot directly in front of the other. If you feel that you cannot place your foot directly in front, try to step far enough ahead that the heel of your forward foot is ahead of the toes of the other foot. (To score 3 points, the length of the step should exceed the length of the other foot and the width of the stance should approximate the participant's normal stride width.)

- 4 able to place foot tandem independently and hold 30 seconds
- 3 able to place foot ahead independently and hold 30 seconds
- 2 able to take small step independently and hold 30 seconds
- 1 needs help to step but can hold 15 seconds
- 0 loses balance while stepping or standing

STANDING ON ONE LEG

INSTRUCTIONS: Stand on one leg as long as you can without holding on.

- 4 able to lift leg independently and hold > 10 seconds
- 3 able to lift leg independently and hold 5-10 seconds
- 2 able to lift leg independently and hold L 3 seconds
- 1 tries to lift leg unable to hold 3 seconds but remains standing independently.
- 0 unable to try of needs assist to prevent fall

TOTAL SCORE (Maximum = 56)

Appendix B

Tinetti Gait and Balance Assessment

Participant Code: _____

TINETTI BALANCE ASSESSMENT TOOL

BALANCE SECTION

Patient is seated in hard, armless chair:

			Pre-Intervention	Post-Intervention
Sitting Balance	Leans or slides in chair	=0		
	Steady, safe	=1		
Rises from chair	Unable to without help	=0		
	Able, uses arms to help	=1		
	Able without use of arms	=2		
Attempts to rise	Unable to without help	= 0		
	Able, requires > 1 attempt	= 1		
	Able to rise, 1 attempt	= 2		
Immediate standing balance (first 5 seconds)	Unsteady (staggers, moves feet, trunk sway)	= 0		
	Steady but uses walker or other support	= 1		
	Steady without walker or other support	= 2		
Standing balance	Unsteady	= 0		
	Steady but wide stance and uses support	= 1		
	Narrow stance without support	= 2		
Nudged	Begins to fall	= 0		
	Staggers, grabs, catches self	= 1		
	Steady	= 2		
Eyes closed	Unsteady	= 0		
	Steady	= 1		
Turning 360 degrees	Discontinuous steps	= 0		
	Continuous	= 1		
	Unsteady (grabs, staggers)	= 0		
	Steady	= 1		
Sitting down	Unsafe (misjudged distance, falls into chair)	= 0		
	Uses arms or not a smooth motion	= 1		
	Safe, smooth motion	= 2		
		Balance Score	/16	/16

GAIT SECTION

Patient stands with therapist, walks across room (+/- aids), first at usual pace, then at rapid pace.

			Pre-Intervention	Post-Intervention
Indication of gait (immediately after told to 'go')	Any hesitancy or multiple attempts	= 0		
	No hesitancy	= 1		
Step length and height	Step through L	= 0		
	Step through R	= 1		
	Step to	= 1		
Foot clearance	Foot drop	= 0		
	L foot clears floor	= 1		
	R foot clears floor	= 1		
Step symmetry	Right and left step length not equal	= 0		
	Right and left step length appear equal	= 1		
Step continuity	Steps appear continuous	= 0		
	Stopping or discontinuity between steps	= 1		
Path	Marked deviation	= 0		
	Mild/moderate deviation or uses w. aid	= 1		
	Straight without w. aid	= 2		
Trunk	Marked sway or uses w. aid	= 0		
	No sway but flex. knees or back or uses arms for stability	= 1		
	No sway, flex., use of arms or w. aid	= 2		
Walking time	Heels apart	= 0		
	Heels almost touching while walking	= 1		
			Gait Score	/12
			Balance Score (carried forward)	/16
Total Score = Balance + Gait Score			/28	/28

Risk Indicators:

Tinetti Tool Score

≤18
19-23
≥24

Risk of Falls

High
Moderate
Low

Appendix C
SF-36 Health Survey

Participant Code: _____

SF-36(tm) Health Survey

Instructions for completing the questionnaire: Please answer every question. Some questions may look like others, but each one is different. Please take the time to read and answer each question carefully by filling in the bubble that best represents your response.

1. In general, would you say your health is:

- Excellent
- Very good
- Good
- Fair
- Poor

2. Compared to one year ago, how would you rate your health in general now?

- Much better now than a year ago
- Somewhat better now than a year ago
- About the same as one year ago
- Somewhat worse now than one year ago
- Much worse now than one year ago

3. The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

a. Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports.

- Yes, limited a lot.
- Yes, limited a little.
- No, not limited at all.

b. Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf?

- Yes, limited a lot.
- Yes, limited a little.
- No, not limited at all.

c. Lifting or carrying groceries.

- Yes, limited a lot.
- Yes, limited a little.
- No, not limited at all.

d. Climbing several flights of stairs.

- Yes, limited a lot.
- Yes, limited a little.
- No, not limited at all.

e. Climbing one flight of stairs.

- Yes, limited a lot.
- Yes, limited a little.
- No, not limited at all.

f. Bending, kneeling or stooping.

- Yes, limited a lot.
- Yes, limited a little.
- No, not limited at all.

g. Walking more than one mile.

- Yes, limited a lot.
- Yes, limited a little.
- No, not limited at all.

h. Walking several blocks.

- Yes, limited a lot.
- Yes, limited a little.
- No, not limited at all.

i. Walking one block.

- Yes, limited a lot.
- Yes, limited a little.
- No, not limited at all.

j. Bathing or dressing yourself.

- Yes, limited a lot.
- Yes, limited a little.
- No, not limited at all.

4. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

- a. Cut down the amount of time you spent on work or other activities?
 Yes No

b. Accomplished less than you would like?

Yes No

c. Were limited in the kind of work or other activities

Yes No

d. Had difficulty performing the work or other activities (for example, it took extra time)

Yes No

5. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?

a. Cut down the amount of time you spent on work or other activities?

Yes No

b. Accomplished less than you would like

Yes No

c. Didn't do work or other activities as carefully as usual

Yes No

6. During the past 4 weeks, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?

- Not at all
- Slightly
- Moderately
- Quite a bit
- Extremely

7. How much bodily pain have you had during the past 4 weeks?

- Not at all
- Slightly
- Moderately
- Quite a bit
- Extremely

8. During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?

- Not at all
- Slightly
- Moderately
- Quite a bit
- Extremely

9. These questions are about how you feel and how things have been with you during the past 4 weeks. For each question, please give the one answer that comes closest to the way you have been feeling. How much of the time during the past 4 weeks.

a. did you feel full of pep?

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

b. have you been a very nervous person?

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

c. have you felt so down in the dumps nothing could cheer you up?

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

d. have you felt calm and peaceful?

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

e. did you have a lot of energy?

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

f. have you felt downhearted and blue?

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

g. did you feel worn out?

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

h. have you been a happy person?

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

i. did you feel tired?

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

10. During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting friends, relatives, etc.)?

- All of the time
- Most of the time
- Some of the time
- A little of the time
- None of the time

11. How TRUE or FALSE is each of the following statements for you?

a. I seem to get sick a little easier than other people

- Definitely true
- Mostly true
- Don't know
- Mostly false
- Definitely false

b. I am as healthy as anybody I know

- Definitely true
- Mostly true
- Don't know
- Mostly false
- Definitely false

c. I expect my health to get worse

- Definitely true
- Mostly true
- Don't know
- Mostly false
- Definitely false

d. My health is excellent

- Definitely true
- Mostly true
- Don't know
- Mostly false
- Definitely false

Appendix D
Wii Fit Enjoyment Questionnaire

Participant Code: _____

Questionnaire

Please answer each question honestly. Answer by circling the statement that best matches your response. Thank you.

1. How much **enjoyment** did you find in playing the Wii Fit games?

High Moderate Low No Enjoyment

2. How much did your **motivation** increase to complete balance exercises while participating in the Wii Fit games?

High Moderate Low No Increase in Motivation

3. How **challenging** did you find the games on the Wii Fit?

High Moderate Low No Challenge

4. How much improvement in your **balance** did you experience after playing the Wii Fit games?

High Moderate Low No Improvement in Balance

5. How would you compare the Wii Fit games to traditional balance exercises?

So Much Better Somewhat Better The Same; Not Any Better
Better

6. What is your level of **interest** in continuing to use the Wii Fit in the future?

High Moderate Low Not Interested

Appendix E
Consent Form (English)



CONSENT TO PARTICIPATE IN A RESEARCH STUDY

Title of Research Study: *The Effect of the Nintendo Wii Fit and Exercise Improving Balance and Quality of Life in Community Dwelling Elders*

Researcher: Karen Jacobs, EdD, CPE, OTR/L, FAOTA Clinical Professor
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Purpose: As we age, physical capacities such as cardiovascular and musculoskeletal systems and body structure can slowly decline. It is important to continue to engage in physical activity as you age. Improved balance can improve your quality of life and improve your ability to walk to prevent falls and associated injuries. The purpose of this research is to determine the usability of Wii as a health game to improve balance and quality of life in community dwelling elders as well as compare it against a program already in use—Matter of Balance.



 CRC-IRB Approval: 7/20/10-7/9/11
 Protocol #2266

Requirements: To participate in this research study you must be at least 60 years old, live independently within the community, have the ability to see the television clearly from 8 to 10 feet away and have the ability to walk or move around independently with or without a cane or walker.

Procedures: If you agree to volunteer to be part of this research project, you will be asked to complete three balance assessments at the beginning and end of the study. In addition to the assessments a Demographic Questionnaire will be completed at the beginning of the study. The Short Form-36 Health Survey will be completed at the beginning and end of the study. An Enjoyment Questionnaire will be completed at the end of the study. These questionnaires will be used to collect information on quality of life.

The total anticipated number of participants will be 90. The participants will be randomly assigned to one of three groups: the control group or experimental group 1 or 2.

Participants in the control group will not participate in additional exercise.

Participants in experimental group 1 will receive the following over a period of three weeks: 1) Wii Fit training for 20 minutes twice a week; and 2) home exercises which are designed to supplement the Wii Fit training by incorporating the movements used in the game.

Participants in experimental group 2 will participate in the Matter of Balance Program, administered by Catrina Inzerillo, B.S. Exercise Physiology and home exercises. The Matter of Balance Program emphasizes practical strategies to reduce the fear of falling and increase activity levels.

Confidentiality: All information obtained in this research project will be considered private, only researchers and you will know what you say. The information you give will be used for research only. All information you give will be coded by an ID number, and will be kept in a locked file at Boston University. Your ID number and name will not be kept together and the information you give the investigator will not be traceable back to you by anyone outside of the research team.

Benefits: By participating in the research project, experimental group participants will learn about the effects of Wii on promoting health, balance, and well-being. There are no direct benefits to the participant, although their balance may improve.

CRC-IRB Approval: 7/20/10-7/9/11
Protocol #2266

A circular stamp with the text "CRC IRB" inside, positioned to the right of the approval text.

Compensation: Each participant will receive a \$25 gift certificate to a local supermarket upon completion of study participation.

Risks: There are minimal risks for you if you decide to participate in the study. You may experience joint or muscle pain from repetitive motion. You may also experience motion sickness. As with any form of physical activity, there is a risk of injury or that you could fall. However, we have designed this study to minimize the risks of all these conditions. If an injury occurs during this study as a result of the research procedures you can receive medical care at one of the area hospitals. However, no special provision has been made for payment for your treatment solely because of your participation in this experiment. This is a statement of the Boston University policy. This does not represent a waiver of any of your legal rights.

Questions: The researcher will explain the study to you and see if you have any questions. However, if you have any questions about this study later on, you can ask Karen Jacobs at (617) 353-7516. You may obtain more information about your rights as a research participant by contacting the Institutional Review Board for the Protection of Human Participants at the Boston University Charles River Campus at (617) 358-6115. Participants will be given a copy of this consent form to keep.

Right to Refuse or Withdraw: Your participation is voluntary, and refusal to participate will not result in any penalty or loss of benefits to which you are entitled.

Participant's Signature

Date

Participant's Name Printed

I have explained to the above-named participant the nature and purpose of the research described above and the foreseeable risks, discomfort, and benefits that may result. I have asked the participant if any questions have arisen regarding the procedure and have answered these questions to the best of my ability.

Signature of investigator or designee

Date

CRC-IRB Approval: 7/20/10-7/19/11
Protocol # 2766



Consent Form (Russian)

СОГЛАСИЕ НА УЧАСТИЕ В ИССЛЕДОВАНИИ

Название исследования: *Влияние физкультурных видео-игр и упражнений по улучшению равновесия на качество жизни пожилых.*

Исследователь: Керен Джейкобе, Доктор Педагогических наук, Профессор Бостонского Университета, Колледж Здравоохранения и Реабилитации, Факультет Трудотерапии.

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Тел. 201-341-8307

Цель проекта: По мере старения, сердечно-сосудистая и костно-мышечная системы постепенно слабеют. Поэтому очень важно продолжать физическую активность. Улучшение равновесия способствует улучшению качества жизни, способности ходить, не падая. Цель данного исследования - определить эффективность Wii – оздоровляющей физкультурной видео-игры - в жизни пожилых в сравнении с уже существующей системой упражнений.

Требования: Для участия в этом исследовании Вы должны быть не моложе 60 лет, жить независимо, быть способным(ой) ясно видеть телевизионные передачи на расстоянии 8-10 футов, независимо передвигаться с палочкой или вожером, или без них.

Стадии исследования: Если Вы согласны участвовать в этом проекте, Вас попросят пройти 3 проверки Вашего равновесия в начале и в конце этой программы. Еще будет заполнен демографический вопросник в начале проекта. Короткая Форма-36 также будет заполнена в начале и в конце проекта. Эти вопросники нужны для сбора информации о качестве Вашей жизни.

Общее количество участников в проекте 90 человек. Участников выборочно распределят в три группы: контрольную и экспериментальные 1 или 2.

Участники контрольной группы не участвуют в дополнительных упражнениях.

Участники группы 1 в течение трёх недель:

1/ будут тренироваться физкультурной видео-игре по 20 минут дважды в неделю;
2/ будут дома делать упражнения, дополнившие те, которые были в Wii видео-игре.

Участники группы 2 будут заняты в программе «Все дело в равновесии», проводимой Катриной Инзерилло, бакалавром науки в области психологии, и будут делать упражнения дома. Программа «Все дело в равновесии» особенно занята разработкой способов по уменьшению страха падений, а также повышению уровня активности.

Конфиденциальность: Вся информация, собранная во время исследования, строго конфиденциальна и все, что Вы будете говорить, будет известно только Вам и исследователю. Вся информация, полученная от Вас, будет использована только в целях науки и будет закодирована особым номером и храниться в запечатом ящике в Бостонском Университете. Ваш кодированный номер и Ф.И.О. будут храниться отдельно и, таким образом, никак не прослеживаться к Вам кем бы то ни было вне проекта.

Полезьа: Участвуя в этом проекте, члены экспериментальной группы узнают как видео игра Wii влияет на улучшение здоровья, равновесия и общего самочувствия. Прямого эффекта может и не быть, но равновесие может улучшиться.

Компенсация: По завершении программы каждый участник проекта получит подарочный талон на сумму \$20 (долларов) в местный супермаркет.

Риск от участия в проекте минимален. Вы можете испытать некоторую боль в суставах и мышцах от повторных движений, а также тошноту. Как и при любой форме физической активности, есть риск повреждений и возможности падения. Однако эта программа спланирована так, что риск практически сведен на нет. В случае же повреждения в ходе проекта, Вам будет предоставлена медицинская помощь в одном из ближайших госпиталей. Однако, нет такого условия, что эта помощь будет оплачена только на основании Вашего участия в этом проекте. Таково правило Бостонского Университета. Но это не отменяет Ваши юридические права.

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получаемые Вами льготы.

Подпись участника (Participant's Signature)

Date

ФИО участника разборчиво (Participant's Name Printed)

I have explained to the above-named participant the nature and purpose of the research described above and foreseeable risks, discomfort, and benefits that may result. I have asked that participant if any questions have arisen regarding the procedure and have answered these questions to the best of my ability.

Signature of investigator or designee

Date

Appendix F

Supplemental Home Exercises (National Institute on Aging, 2010) and Checklists

Upper Body Exercises

Wrist Curl

This exercise will strengthen your wrists. It also will help ensure good form and prevent injury when you do upper body strength exercises.

1. Rest your forearm on the arm of a sturdy chair with your hand over the edge.
2. Hold weight with palm facing upward.
3. Slowly bend your wrist up and down.
4. Repeat 10-15 times.
5. Repeat with other hand 10-15 times.
6. Repeat 10-15 more times with each hand.



This exercise will strengthen your shoulders and arms. It should make swimming and other activities such as lifting and carrying grandchildren easier.

Overhead Arm Raise



1. You can do this exercise while standing or sitting in a sturdy, armless chair.
2. Keep your feet flat on the floor, shoulder-width apart.
3. Hold weights at your sides at shoulder height with palms facing forward. Breathe in slowly.
4. Slowly breathe out as you raise both arms up over your head keeping your elbows slightly bent.
5. Hold the position for 1 second.
6. Breathe in as you slowly lower your arms.
7. Repeat 10-15 times.
8. Rest; then repeat 10-15 more times.

TIP

As you progress, use a heavier weight and alternate arms until you can lift the weight comfortably with both arms.

This exercise will strengthen your shoulders and make lifting groceries easier.

Side Arm Raise



1. You can do this exercise while standing or sitting in a sturdy, armless chair.
2. Keep your feet flat on the floor, shoulder-width apart.
3. Hold hand weights straight down at your sides with palms facing inward. Breathe in slowly.
4. Slowly breathe out as you raise both arms to the side, shoulder height.
5. Hold the position for 1 second.
6. Breathe in as you slowly lower your arms.
7. Repeat 10-15 times.
8. Rest; then repeat 10-15 more times.

TIP As you progress, use a heavier weight and alternate arms until you can lift the weight comfortably with both arms.

Front Arm Raise

This exercise for your shoulders can help you put things up on a shelf or take them down more easily.

1. Stand with your feet shoulder-width apart.
2. Hold weights straight down at your sides, with palms facing backward.
3. Keeping them straight, breathe out as you raise both arms in front of you to shoulder height.
4. Hold the position for 1 second.
5. Breathe in as you slowly lower arms.
6. Repeat 10-15 times.
7. Rest; then repeat 10-15 more times.

TIP As you progress, use a heavier weight and alternate arms until you can lift the weight comfortably with both arms.



Arm Curl

After a few weeks of doing this exercise for your upper arm muscles, lifting that gallon of milk will be much easier.

1. Stand with your feet shoulder-width apart.
2. Hold weights straight down at your sides, palms facing forward. Breathe in slowly.
3. Breathe out as you slowly bend your elbows and lift weights toward chest. Keep elbows at your sides.
4. Hold the position for 1 second.
5. Breathe in as you slowly lower your arms.
6. Repeat 10-15 times.
7. Rest; then repeat 10-15 more times.

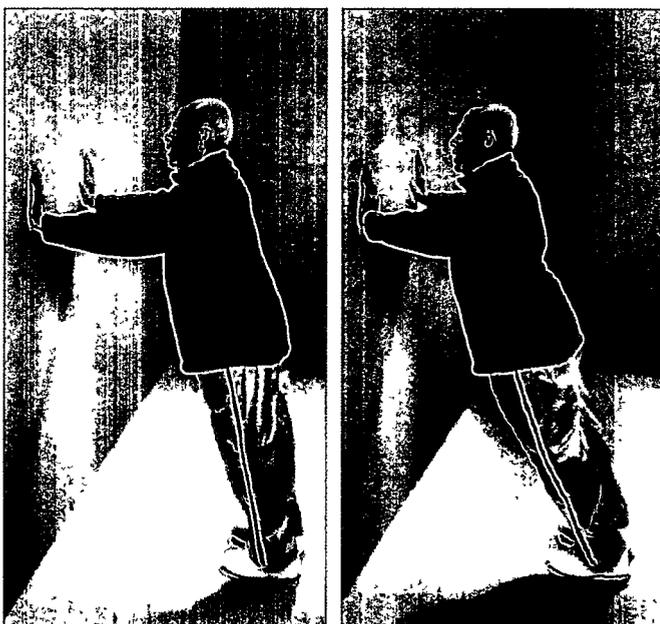


As you progress, use a heavier weight and alternate arms until you can lift the weight comfortably with both arms.



These push-ups will strengthen your arms, shoulders, and chest. Try this exercise during a TV commercial break.

Wall Push-Up



1. Face a wall, standing a little farther than arm's length away, feet shoulder-width apart.
2. Lean your body forward and put your palms flat against the wall at shoulder height and shoulder-width apart.
3. Slowly breathe in as you bend your elbows and lower your upper body toward the wall in a slow, controlled motion. Keep your feet flat on the floor.
4. Hold the position for 1 second.
5. Breathe out and slowly push yourself back until your arms are straight.
6. Repeat 10-15 times.
7. Rest; then repeat 10-15 more times.

Elbow Extension

This exercise will strengthen your upper arms. If your shoulders aren't flexible enough to do this exercise, try the Chair Dip on page 55.

1. You can do this exercise while standing or sitting in a sturdy, armless chair.
2. Keep your feet flat on the floor, shoulder-width apart.
3. Hold weight in one hand with palm facing inward. Raise that arm toward ceiling.
4. Support this arm below elbow with other hand. Breathe in slowly.
5. Slowly bend raised arm at elbow and bring weight toward shoulder.
6. Hold position for 1 second.
7. Breathe out and slowly straighten your arm over your head. Be careful not to lock your elbow.
8. Repeat 10-15 times.
9. Repeat 10-15 times with other arm.
10. Repeat 10-15 more times with each arm.



If it's difficult for you to hold hand weights, try using wrist weights.



This pushing motion will strengthen your arm muscles even if you are not able to lift yourself up off the chair.

Chair Dip



1. Sit in a sturdy chair with armrests with your feet flat on the floor, shoulder-width apart.
2. Lean slightly forward; keep your back and shoulders straight.
3. Grasp arms of chair with your hands next to you. Breathe in slowly.
4. Breathe out and use your arms to push your body slowly off the chair.
5. Hold position for 1 second.
6. Breathe in as you slowly lower yourself back down.
7. Repeat 10-15 times.
8. Rest; then repeat 10-15 more times.

Lower Body

Back Leg Raise

1. Stand behind a sturdy chair, holding on for balance. Breathe in slowly.
2. Breathe out and slowly lift one leg straight back without bending your knee or pointing your toes. Try not to lean forward. The leg you are standing on should be slightly bent.
3. Hold position for 1 second.
4. Breathe in as you slowly lower your leg.
5. Repeat 10-15 times.
6. Repeat 10-15 times with other leg.
7. Repeat 10-15 more times with each leg.

TIP As you progress, you may want to add ankle weights.



This exercise strengthens hips, thighs, and buttocks. For an added challenge, you can modify the exercise to improve your balance. (See Progressing to Improve Balance on page 68.)

Side Leg Raise



1. Stand behind a sturdy chair with feet slightly apart, holding on for balance. Breathe in slowly.
2. Breathe out and slowly lift one leg out to the side. Keep your back straight and your toes facing forward. The leg you are standing on should be slightly bent.
3. Hold position for 1 second.
4. Breathe in as you slowly lower your leg.
5. Repeat 10-15 times.
6. Repeat 10-15 times with other leg.
7. Repeat 10-15 more times with each leg.

TIP As you progress, you may want to add ankle weights.

Knee Curl

1. Stand behind a sturdy chair, holding on for balance. Lift one leg straight back without bending your knee or pointing your toes. Breathe in slowly.
2. Breathe out as you slowly bring your heel up toward your buttocks as far as possible. Bend only from your knee, and keep your hips still. The leg you are standing on should be slightly bent.
3. Hold position for 1 second.
4. Breathe in as you slowly lower your foot to the floor.
5. Repeat 10-15 times.
6. Repeat 10-15 times with other leg.
7. Repeat 10-15 more times with each leg.

TIP As you progress, you may want to add ankle weights.

Walking and climbing stairs are easier when you do both the Knee Curl and Leg Straightening exercises. For an added challenge, you can modify the exercise to improve your balance. (See Progressing to Improve Balance on page 68.)



This exercise strengthens your thighs and may reduce symptoms of arthritis of the knee.

Leg Straightening

1. Sit in a sturdy chair with your back supported by the chair. Only the balls of your feet and your toes should rest on the floor. Put a rolled bath towel at the edge of the chair under thighs for support. Breathe in slowly.
2. Breathe out and slowly extend one leg in front of you as straight as possible, but don't lock your knee.
3. Flex foot to point toes toward the ceiling. Hold position for 1 second.
4. Breathe in as you slowly lower leg back down.
5. Repeat 10-15 times.
6. Repeat 10-15 times with other leg.
7. Repeat 10-15 more times with each leg.

TIP As you progress, you may want to add ankle weights.



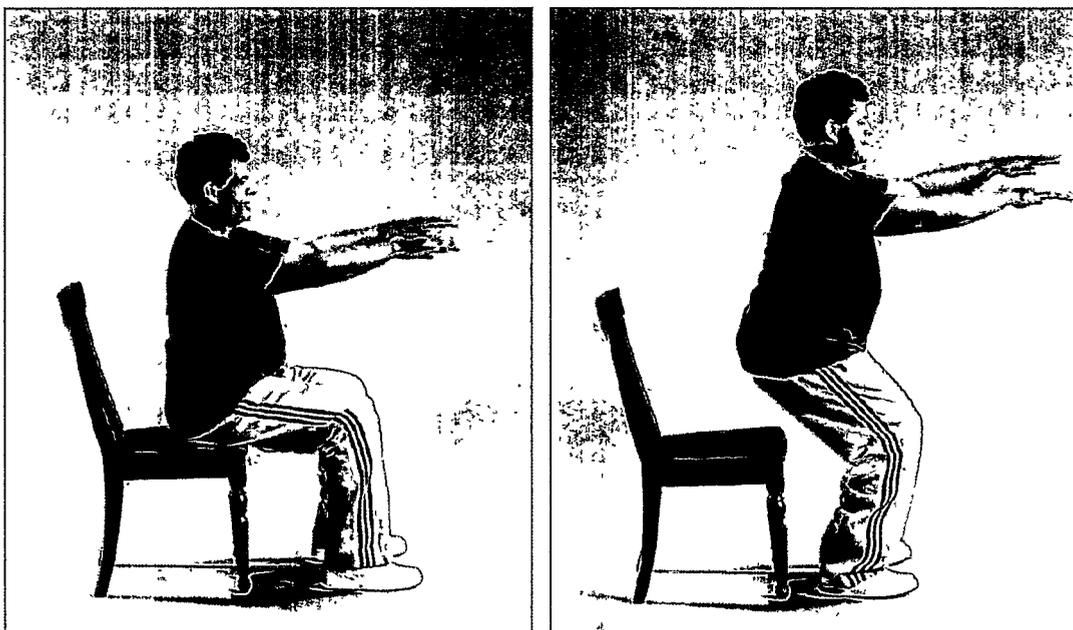
Chair Stand

This exercise, which strengthens your abdomen and thighs, will make it easier to get in and out of the car. If you have knee or back problems, talk with your doctor before trying this exercise.

1. Sit toward the front of a sturdy, armless chair with knees bent and feet flat on floor, shoulder-width apart.
2. Lean back with your hands crossed over your chest. Keep your back and shoulders straight throughout exercise. Breathe in slowly.
3. Breathe out and bring your upper body forward until sitting upright.
4. Extend your arms so they are parallel to the floor and slowly stand up.
5. Breathe in as you slowly sit down.
6. Repeat 10-15 times.
7. Rest; then repeat 10-15 more times.



TIP People with back problems should start the exercise from the sitting upright position.



Toe Stand

This exercise will help make walking easier by strengthening your calves and ankles. For an added challenge, you can modify the exercise to improve your balance. (See Progressing to Improve Balance on page 68.)

1. Stand behind a sturdy chair, feet shoulder-width apart, holding on for balance. Breathe in slowly.
2. Breathe out and slowly stand on tiptoes, as high as possible.
3. Hold position for 1 second.
4. Breathe in as you slowly lower heels to the floor.
5. Repeat 10-15 times.
6. Rest; then repeat 10-15 more times.

TIP As you progress, try doing the exercise standing on one leg at a time for a total of 10-15 times on each leg.



Balance

You can do this exercise while waiting for the bus or standing in line at the grocery. For an added challenge, you can modify the exercise to improve your balance. (See Progressing to Improve Balance on page 68.)

Stand on One Foot



1. Stand on one foot behind a sturdy chair, holding on for balance.
2. Hold position for up to 10 seconds.
3. Repeat 10-15 times.
4. Repeat 10-15 times with other leg.
5. Repeat 10-15 more times with each leg.

Flexibility Exercises

Shoulder

This exercise to stretch your shoulder muscles will help improve your posture.

1. Stand back against a wall, feet shoulder-width apart and arms at shoulder height.
2. Bend your elbows so your fingertips point toward the ceiling and touch the wall behind you. Stop when you feel a stretch or slight discomfort, and stop immediately if you feel sharp pain.
3. Hold position for 10-30 seconds.
4. Let your arms slowly roll forward, remaining bent at the elbows, to point toward the floor and touch the wall again, if possible. Stop when you feel a stretch or slight discomfort.
5. Hold position for 10-30 seconds.
6. Alternate pointing above head, then toward hips.
7. Repeat at least 3-5 times.

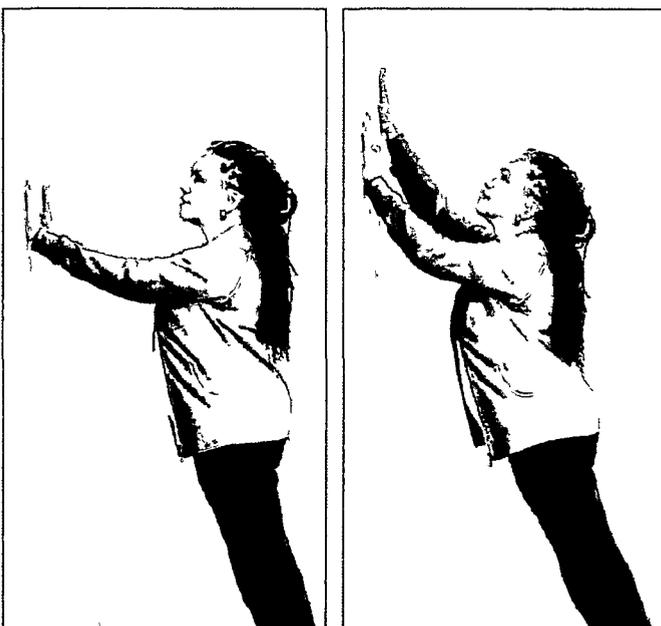


Upper Body

This exercise increases the flexibility of your arms, chest, and shoulders, and will help you reach items on the upper shelves of your closet or kitchen cabinet.

1. Stand facing a wall slightly farther than arm's length from the wall, feet shoulder-width apart.
2. Lean your body forward and put your palms flat against the wall at shoulder height and shoulder-width apart.
3. Keeping your back straight, slowly walk your hands up the wall until your arms are above your head.
4. Hold your arms overhead for about 10-30 seconds.
5. Slowly walk your hands back down.
6. Repeat at least 3-5 times.

TIP As you progress, the goal is to reach higher.



This exercise, which stretches the chest muscles, is also good for your posture.

Chest



1. You can do this stretch while standing or sitting in a sturdy, armless chair.
2. Keep your feet flat on the floor, shoulder-width apart.
3. Hold arms to your sides at shoulder height, with palms facing forward.
4. Slowly move your arms back, while squeezing your shoulder blades together. Stop when you feel a stretch or slight discomfort.
5. Hold the position for 10-30 seconds.
6. Repeat at least 3-5 times.

Upper Back

This exercise is good for your shoulders and upper-back muscles.

1. Sit in a sturdy, armless chair with your feet flat on the floor, shoulder-width apart.
2. Hold arms in front of you at shoulder height with palms facing outward.
3. Relax your shoulders, keep your upper body still, and reach forward with your hands. Stop when you feel a stretch or slight discomfort.
4. Hold position for 10-30 seconds.
5. Sit back up.
6. Repeat at least 3-5 times.

TIP As you progress, cross your arms and interlace fingers.



This exercise stretches your ankle muscles. You can stretch both ankles at once or one at a time.



Ankle

1. Sit securely toward the edge of a sturdy, armless chair.
2. Stretch your legs out in front of you.
3. With your heels on the floor, bend your ankles to point toes toward you.
4. Hold the position for 10-30 seconds.
5. Bend ankles to point toes away from you and hold for 10-30 seconds.
6. Repeat at least 3-5 times.

Here's another exercise that stretches your thigh muscles. If you've had hip or back surgery, talk with your doctor before trying this stretch.



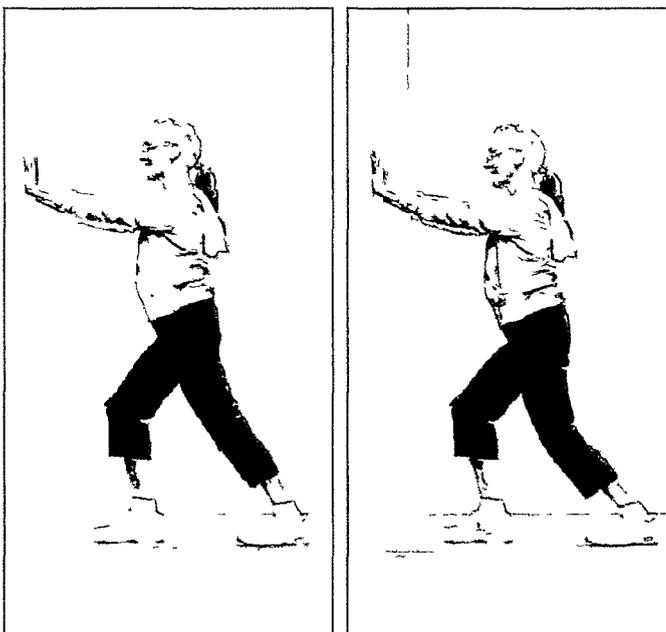
Thigh Standing

1. Stand behind a sturdy chair with your feet shoulder-width apart and your knees straight, but not locked.
2. Hold on to the chair for balance with your right hand.
3. Bend your left leg back and grab your foot in your left hand. Keep your knee pointed to the floor. If you can't grab your ankle, loop a resistance band, belt, or towel around your foot and hold both ends.
4. Gently pull your leg until you feel a stretch in your thigh.
5. Hold position for 10-30 seconds.
6. Repeat at least 3-5 times.
7. Repeat at least 3-5 times with your right leg.

Calf

Because many people have tight calf muscles, it's important to stretch them.

1. Stand facing a wall slightly farther than arm's length from the wall, feet shoulder-width apart.
2. Put your palms flat against the wall at shoulder height and shoulder-width apart.
3. Step forward with right leg and bend right knee. Keeping both feet flat on the floor, bend left knee slightly until you feel a stretch in your left calf muscle. It shouldn't feel uncomfortable. If you don't feel a stretch, bend your right knee until you do.
4. Hold position for 10-30 seconds, and then return to starting position.
5. Repeat with left leg.
6. Continue alternating legs for at least 3-5 times on each leg.



Appendix F
Supplemental Home Exercises and Checklist

Week 1

	11/1/10	11/2/10	11/3/10	11/4/10	11/5/10	11/6/10	11/7/10
Exercises							
Upper Body Strengthening							
Wrist Curl							
Overhead Arm Raise							
Front Arm Raise							
Arm Curl							
Lower Body Strengthening							
Back Leg Raise							
Side Leg Raise							
Leg Straightening							
Toe Stand							
Balance Exercises							
Stand on 1 Foot							
Flexibility Exercises							
Shoulder							
Upper Body							
Chest							
Upper Back							
Ankle							
Thigh Standing							
Calf							

Week 2

	11/8/10	11/9/10	11/10/10	11/11/10	11/12/10	11/13/10	11/14/10
Exercises							
Upper Body Strengthening							
Side Arm Raise							
Wall Push Up							
Elbow Extension							
Chair Dip							
Lower Body Strengthening							
Side Leg Raise							
Knee Curl							
Leg Straightening							
Toe Stand							
Balance Exercises							
Stand on 1 Foot							
Flexibility Exercises							
Shoulder							
Upper Body							
Chest							
Upper Back							
Ankle							
Thigh Standing							
Calf							

Week 3

	11/15/10	11/16/10	11/17/10	11/18/10	11/19/10	11/20/10	11/21/10
Exercises							
Upper Body Strengthening							
Overhead Arm Raise							
Front Arm Raise							
Arm Curl							
Chair Dip							
Lower Body Strengthening							
Back Leg Raise							
Side Leg Raise							
Knee Curl							
Chair Stand							
Balance Exercises							
Stand on 1 Foot							
Flexibility Exercises							
Shoulder							
Upper Body							
Chest							
Upper Back							
Ankle							
Thigh Standing							
Calf							

Appendix G

Matter of Balance Exercises

A MATTER OF BALANCE / SESSION 3
HANDOUT 3.2

EXERCISE AND FALL PREVENTION
 A MATTER OF BALANCE EXERCISES
 (PG 1 OF 12)

This exercise prepares the mind and body for exercise.

WARM-UP EXERCISES

Deep Breathing

Place your hands on stomach and take a deep breath in, filling your diaphragm. Feel your hands move out as you fully breath. Exhale and feel hands your hands return.



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Coaching Tip: Sit in a sturdy, comfortable chair. Breathe evenly. Encourage participant to breathe normally throughout the exercise.

Start with 3 to 5 repetitions for each of the warm-up exercises. Increase to 8 to 12 repetitions, as appropriate.

Good Morning Stretch

Stretch your arms wide. Take a deep breath and exhale, stretch some more, add a gentle turn to the left and then to the right. Move slowly and breathe deeply.

The Good Morning Stretch and Shoulder Rolls improve the range of motion of the shoulders and upper back and they are an excellent way to relieve muscle tension.

Shoulder Rolls

Roll your shoulders forward, making small circles for a count of 5. Then roll your shoulders to the back for a count of 5.

One set is 10 counts.



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A MATTER OF BALANCE / SESSION 3
HANDOUT 3.2

EXERCISE AND FALL PREVENTION
 A MATTER OF BALANCE EXERCISES
 (PG 2 OF 12)

Diagonal Arm Press Across the Body

Starting with your left arm, press to the right, away from and across your body. Alternate your right and left arm. Repeat 5 to 10 times.

Pause, take 2 or 3 deep breaths.

Coaching Tip: This is a good time to check-in with each participant with eye contact and conversation.

Foot Circles

Sit with both feet on floor. Raise one foot and gently circle (rotate) your foot in a clockwise direction 5 times. Change direction and repeat.

Switch to the other foot and repeat.



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Seated Knee Raises (Seated Marching)

Lift your left knee and then lower it. Lift your right knee and lower it, as if you were marching.

Repeat 5 to 10 times.

Coaching Tip: Encourage a comfortable range of motion. More motion is not always better. For individuals with joint replacement or experiencing hip/back pain, encourage them to follow their physician/therapists' recommendations.



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This exercise warms the body and can improve your upper body range of motion, overall balance and physical endurance.

The ankle is one of the most important "balance" joints. The ankle joint "responds" to changes in terrain and "reports" to the brain and other muscles information necessary for adjustment and safety. Ankle rolls may improve range of motion and balance.

Seated Knee Raises improves hip stability and range of motion. May help physical endurance.

A MATTER OF BALANCE / SESSION 3
HANDOUT 3.2

EXERCISE AND FALL PREVENTION
 A MATTER OF BALANCE EXERCISES
 (PG 3 OF 12)

Pause, take 2 or 3 deep breaths.

STRENGTH AND BALANCE EXERCISES

Diagonal Arm Press Across the Body and Toward the Floor

Starting with your left arm, press to the right, toward the floor and across your body. Alternate your right and left arm.

Repeat 5 to 10 times. Add a set as participants get stronger.

Diagonal Arm Press Across the Body and Slightly Overhead

Starting with your left arm, press to the right, toward the ceiling and across your body. Alternate your right and left arm.

Repeat 5 to 10 times. Add a set as participants get stronger.

Coaching Tip: Strength and balance exercises are diverse and are sometimes paced and rhythmic or very slow and controlled. Coaches should demonstrate each exercise according to the plan. All movements should be controlled and in a full range of motion. Suggestions regarding pace, range of motion and repetitions should be made according to an individual's ability.

This exercise improves the range of motion in the shoulders and back. It may also improve physical endurance.

This exercise improves the range of motion in the shoulders and back. It may also improve physical endurance.

A MATTER OF BALANCE / SESSION 3
HANDOUT 3.2

EXERCISE AND FALL PREVENTION
A MATTER OF BALANCE EXERCISES
 (PG 4 OF 12)

Rowing Exercise

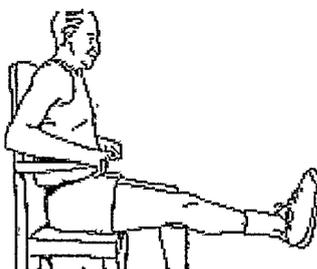
With both arms straight out in front of your body, pull arms in, as if you are rowing a boat. Try to pinch your shoulder blades together as you row.

Repeat cycle 5 to 10 times. Add a set as appropriate.

Seated Leg Extensions

Slowly straighten your left leg and then return your left leg to the floor.

Slowly straighten your right leg and then return your right leg to the floor.



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Alternate and repeat 5 to 10 times.

Add a set as participants get stronger.

Coaching Tip: Participants can do this exercise with the toe pointed or fixed toward the ceiling. The stretch felt in the calf muscle will vary depending on the position of the foot.

Seated Knee Raises
(Not Alternating)

First, lift your left knee and then lower it. Repeat 5 to 10 times.

Second, lift your right knee and then lower it. Repeat 5-10 times.



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This exercise improves torso, hip and upper leg strength.

Take a deep breath and stand up.

Coaching Tip: When transitioning from seated to standing or standing to seated encourage a slow and controlled movement to avoid dizziness. Always have a chair or sturdy table available for support.

Encourage the following:

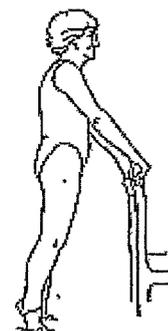
- *Keep your head up and eyes open.*
- *Maintain an upright posture.*
- *Breathe normally and do each exercise to your own ability.*

This exercise improves balance and leg strength.

Toe Stands (Heel Raises)

Stand behind your chair. Use the chair for support. Place your feet about shoulder width apart and lift up your heels, rising up on to your toes. Pause, then return your heels to the floor.

Repeat 5-10 times. Add a set or practice on one foot, if appropriate.



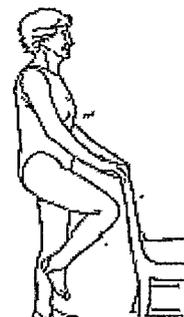
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This exercise improves balance and physical endurance.

Alternating Steps (Marching In Place)

Start marching, alternating steps at a slow to moderate pace. Continue for 15 to 30 seconds.

Increase duration or add a set as appropriate.



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Side Stepping

Step your left foot to the left, then step your right foot to match your left foot.

Step your right foot back to the right, then step your left foot to match your right foot. Continue for 15 to 30 seconds.

(Left together, right together, left together, right together...).

Increase duration or add a set as appropriate.

The Box Step (Waltz)

Right foot forward, then feet together.

Left foot to side, then feet together.

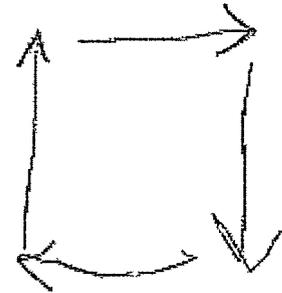
Left foot back, then feet together.

Right foot right, then feet together.

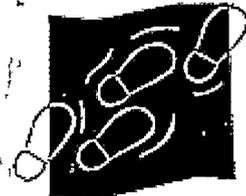
Repeat cycle 3 to 5 times, increase as appropriate.

Pause. Take 2 or 3 deep breaths.

Coaching Tip: Check-in. Participants may be experiencing fatigue at this point. Continue if appropriate or sit down and continue with the seated exercises. Always encourage participants to exercise according to their own ability.



This exercise improves balance, coordination and physical endurance.



Each of the hip/leg exercise improves strength, range of motion and balance.

Standing Hip Extension

Stand behind a chair or sturdy table, slide your foot back, sliding from heel to toe, finishing with leg back and toe pointed, touching the ground.

Coaching Tip: Encourage participants to keep their toe on the floor, their head up, eyes forward and body upright.

Repeat 5 to 10 times with each leg.

Leg Lift to the Side

Lift left leg out to the side, pause, bring it back to mid-line. Touch your left heel to your right toe.

Repeat 5 to 10 times.

Lift right leg out to the side, pause, bring it back to mid-line. Touch your right heel to your left toe.

Repeat 5 to 10 times.

Coaching Tip: Encourage participants to keep their toe on the floor, their head up, eyes forward and body upright.

Coaching Tip: Encourage a comfortable range of motion. More motion is not always better. Encourage individuals with joint replacement or experiencing hip/back pain to follow their physician/therapist's recommendations.

A MATTER OF BALANCE / SESSION 3
HANDOUT 3.2

EXERCISE AND FALL PREVENTION
 A MATTER OF BALANCE EXERCISES
 (PG 8 OF 12)

Take 2 or 3 deep breaths. Transition slowly to your seat.

Wrist Rise & Fall

Place your arms on the armrest of the chair. Gently let your hand hang off the edge of the armrest. (Use tabletop if armrests are not available).

Slowly bend the back of your hand, lift your fingers up toward the ceiling. Then gently lower your hand.

Repeat 5 times, increase as appropriate.

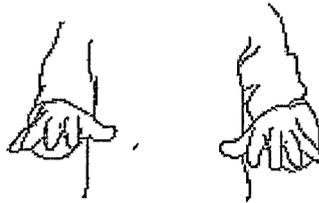


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This exercise may improve dexterity, coordination and range of motion.

Finger Spread

Spread fingers of both hands far apart, keeping fingers straight. Then relax hands and fingers into a gentle fist.



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Repeat 5 times, increase as appropriate.

Wrist Rotation

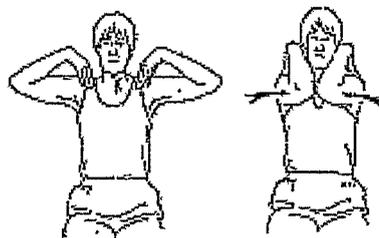
Spread fingers of both hands far apart (like the finger spread.) Then, rotate your hand, palm up, palm down.

Repeat 5 times, increase as appropriate.

Touch Elbows Stretch (front and back)

This exercise helps chest/back flexibility and torso range of motion. It is very good for posture.

Stretch Front: Place your fingertips on your shoulder. Raise elbows to shoulder level. Gently move your elbows together (toward your body's mid-line). Try to get them as close as possible, while still remaining comfortable. Hold for 3-5 seconds.

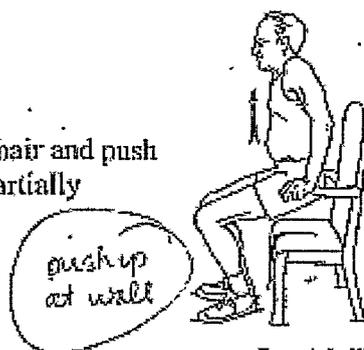


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Arm Chair Push

Put hands on arms of chair and push body up out of chair, partially standing.

Repeat 3-5 times.



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Before returning to a standing position, take two or three deep breaths.

A MATTER OF BALANCE / SESSION 3
HANDOUT 3.2

EXERCISE AND FALL PREVENTION
A MATTER OF BALANCE EXERCISES
 (PG 10 OF 12)

STAND UP

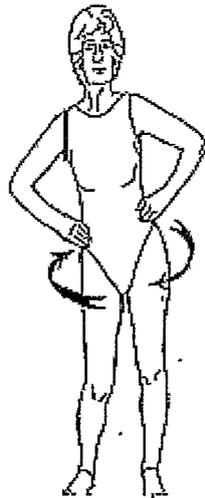
Hip Circles

With your hands on hips, make circles with hips without moving shoulders. Pretend that you are doing the hula dance or playing with a hula-hoop toy.

Do this each direction for 10-15 seconds.

Repeat the cycle 2 times.

Coaching Tip: This is a good exercise to provide verbal cues to insure effective technique. Encourage participants to circle their hips without moving their shoulders. If the shoulders move, it is a sign of limited hip flexibility.



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Standing Foot Circles

Using the chair for support, stand with both feet on the floor, gently raise one heel slightly off the floor, maintaining contact with the floor and your toe.

Circle your heel clockwise.

Repeat 5 times.

Circle foot counter clockwise.

Repeat 5 times.

The ankle joint is very important for balance. Ankle rolls improve range of motion and may improve the ability to adjust to changes in terrain.

A MATTER OF BALANCE / SESSION 3
HANDOUT 3.2

EXERCISE AND FALL PREVENTION
 A MATTER OF BALANCE EXERCISES
 (PG 11 OF 12)

Heel cord flexibility is a strong indicator of overall balance ability and range of motion.

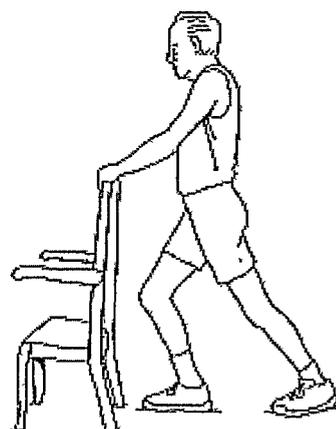
Heel Cord Stretch

Stand about an arm's length away from the chair. With right foot in front of left, lean forward keeping left heel flat on the floor.

Hold 10 to 15 seconds.
 Counting out loud.

Repeat with opposite foot in front.

Repeat cycle 2 times.



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**Before returning to your seat,
 take two or three deep breaths.**

COOL-DOWN

Ear to Shoulder

Bring left ear to left shoulder and hold for 10 seconds.

Repeat to the right.

Repeat cycle 3 times.

Coaching Tip: This is an exercise that can be done anywhere, at anytime. It is a good exercise for the range of motion in the neck and releasing tension.

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