

Effects of the Wii on the Physical and Psychosocial Condition of Older Adults in a Senior

Residential Facility

By

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TABLE OF CONTENTS

	Page
Acknowledgements	ii
Table of Contents	iii
List of Tables	vi

Abstract	vii
Introduction	1
Literature Review	4
Theoretical Framework	4
Physiological Changes with Aging	9
Definition of Physical Activity	15
Physical Activity and Older Adults	17
Physical Activities to Promote Fitness	17
The Use of Computer Games as a Treatment Modality	18
The Nintendo Wii	20
Summary of Literature Review	21
Research Questions	22
Method	22
Study Design	22
Participants	23
Instruments	23
Procedure	29

Statistical Analysis	30
Results	31
Participants	31
Physical Performance	31
Physical Activity	33
Perceived Pain	33
Depression	34
Perceived Improvements in Physical and Psychosocial Status	34
Discussion	36
Physical Performance	36
Physical Activity	38

Perceived Pain	39
Depression	39
Perceived Improvements in Physical and Psychosocial Status	39
Benefits of the Wii Exercise	42
Strengths and Weaknesses	44
Conclusion	45
References	46
Tables	55
Appendix A. Dynamic Gait Index	61
Appendix B. Yale Physical Activity Survey	64
Appendix C. Visual Analog Scale	70

Appendix D. Center for Epidemiologic Studies Depression Scale	72
Appendix E. Interview Questions	73
Appendix F. Recruiting Flyer	74
Appendix G. Consent Form	75

LIST OF TABLES

Table	Title	Page
Table 1	Physical characteristics of the 12 participants	55
Table 2	Results for muscle strength	56
Table 3	Means and SDs for the 6MWT, TU&G, DGI, Reaction Time, YPAS, YPAS Energy Expenditure, VAS, CES-D	57
Table 4	Means and SDs for Joint Range of Motion (degrees)	59

ABSTRACT

The purpose of this study is to determine the effectiveness of the Wii on physical function, pain, activity level, depression, and perceived improvements in physical and psychosocial function in older adults living in a community. Twelve adults aged 76 and older who were living independently in a senior residential community were recruited. After assessing participants' physical function, pain, activity level, and depression, each participant played the Wii for six weeks. After the training, the same assessments were administered and perceived improvements were assessed by a semi-structured interview.

Significant differences were found for muscle strength. According to the results of the interview, all of the participants answered that they enjoyed playing the Wii. It was concluded that playing the Wii could improve the physical function of older adults and could be used as one of the enjoyable physical activities to maintain their fitness.

INTRODUCTION

longevity is increasing and as a result, the population of older people is growing dramatically (Rowe & Kahn, 1998). The population of older adults, individuals 65 years or older, reached 37.3 million in 2006. This represents 12.4% of the entire population meaning that one in every eight Americans is an older adult. Since 1900, the number of older adults increased from 3.1 million to 37.3 million in 2006, which means the percentage of older adults increased from 4.1% in 1900 to 12.4% in 2006 (U.S. Department of Health and Human Services, 2007). As these demographic changes are expected to accelerate over the next two decades, the negative societal effects associated with aging are often seen as inevitable. Therefore, research on health promotion and disease prevention interventions for older adults has become more important (Ory, Hoffman, Hawkins, Sanner, & Mockenhaupt, 2003).

Ory, Hoffman, Hawkins, Sanner and Mockenhaupt (2003) noted that the dissemination of successful health promotion activities and interventions largely depended on our understanding the lives of older adults. Rowe and Kahn (1998) described myths that represent negative bias toward older adults including: "To be old is to be sick", "you can't teach an old dog new tricks" and "the horse is out of the barn" (p. 126). Although there is an absolute inevitability that the possibility of becoming sick and disabled increases as a person ages, the majority of older adults are healthy enough to live independently. They are able to learn new things, and continue to improve their lives by increasing physical activity.

According to Gillis and MacDonald (2005), in addition to the deterioration due to

the aging process, older adults' decrease in activity levels (deconditioning) contributed to decreased functions. The maximal oxygen uptake of sedentary adults older than 60 years of age declines about 10% per decade. Skeletal muscle strength also declines. It begins to decrease at approximately age 50 and is associated with a 30% to 40% decrease in strength by 80 years of age. Loss of skeletal muscle mass below a critical level (sarcopenia) leads to functional impairment. The likelihood of functional impairment and disability is three times greater in older women with sarcopenia and two times greater in older men with sarcopenia

than in older adults with normal skeletal muscle mass (Hughes et al., 2001).

Huang et al. (1998) showed an inverse relationship between functional limitations and physical activities in a follow-up study of men and women aged 40 and older. Men and women of high and moderately high activity levels had a lower prevalence of functional limitations compared with the less active group after controlling for age, body mass index, smoking, alcohol consumption, and presence of chronic disease.

In the Longitudinal Study of Aging, Miller, Rejeski, Reboussin, Tenhave, and Ettinger (2000) investigated how physical activities influenced lower body functional limitations and how those limitations became disabilities in a 6-year follow-up. The participants who reported walking 1.6 km (= 1 mile) at least once per week had a greater probability of improving or sustaining current physical functions than less active participants. The authors suggested that performing routine physical activities might have a positive influence on physical functions and slow the progress of disabilities.

Although functional impairments due to the aging process seem to be inevitable, functional limitations due to an inactive lifestyle might be reversible. Indeed, it has been

suggested that physically active lifestyles may contribute to improving or maintaining health and wellness (Fletcher, Gulanick, & Braun, 2005).

To obtain the maximum effect from a physically active lifestyle, it is important for older adults to perform activity on a regular basis. The key to prolonged engagement in an activity largely depends on whether the activity is motivating and enjoyable. King (1993) used a computer game to motivate her patients. She used either a computer game that required patients to pinch or grasp a controller to play the game or pinch and grip strengthening devices. Patients who participated in the game did significantly more repetitions than those who did the action without the game.

Therefore, when promoting fitness of older adults, fun or enjoyment should be considered, as it may lead to better adherence to regular physical activity. The Wii is a new home video game console launched in September 2006 by Nintendo. The Wii is distinguished by its wireless controller known as the Wii remote, which is a handheld

pointing device that can transmit three dimensional movement and its acceleration to the console. Therefore, when a person plays the Wii, he or she has to physically make a move to control the representing character on the TV screen. The Wii allows a person to play simulated sports, race car driving, fishing, and other games by using a combination of body movements and button clicks.

This type of activity-enhancing video game has been used as an adjunct to rehabilitation therapy in various settings, including hospitals and skilled nursing facilities (Newton, 2008). The present study examines the use and effects of the Wii as a physical activity, which maintains physical and psychosocial functions of older adults in a senior

residential facility. In occupational therapy practice, purposeful and meaningful activities are used to improve one's impaired ability and to promote health and wellness of individuals who engage in the activities.

Therefore, investigating the effects of the Wii, a home video game, which requires body movements to play, is meaningful in the field of occupational therapy.

LITERATURE REVIEW

Theoretical Framework

The Occupational Therapy Practice Framework: Domain and Process (American Occupational Therapy Association [AOTA], 2002) (OTPF) was chosen for the conceptual framework of the present study. This model considers individual client factors as well as the context or environment in which the physical activity is performed when working to enhance fitness promotion of older adults. The purpose of this framework is to define the domain of occupation and to outline the process of occupational therapy (OT) evaluation and intervention.

Occupation

In the OTPF, occupation is defined as an activity a person does to occupy himself or herself. Occupation is a valuable and meaningful activity for the individual as well as the culture or society to which he/she belongs. Occupation occurs within an interaction of person, task, and environment. The term activity is defined as a goal directed human

action. Occupational therapists recognize the importance of both occupation and activity and use them to facilitate people's health and well-being (AOTA, 2002). According to Trombly (2002), life roles have a strong impact on one's occupations and activities. Life

roles are behavior patterns associated with an individual's status in a particular society, where people are expected to act according to the roles. Life roles are divided into three groups: (1) Self-maintenance, (2) Self-advancement, and (3) Self-enhancement (Trombly, 2002).

Self-maintenance roles are associated with looking after oneself, family and home.

Self-advancement roles are those that expect a person to contribute to a productive activity in society. These roles assist the person in gaining skills, possessions, or other benefits.

Self-enhancement roles contribute to an individual's sense of achievement and joy.

Engagement in meaningful occupation satisfies one's life roles, which subsequently affect health and well-being of a person.

Occupation is composed of related activities. For example, if a person likes to jog and considers jogging to be meaningful to his or her life, jogging is his or her occupation. The activities for jogging include tying shoes, stretching joints, and planning a route to run. Abilities and skills, in this context, are factors that comprise activities. Completing an activity requires abilities and skills within a specific context. A person with a great number of highly developed abilities is capable in a variety of activities. Actions including reaching, grasping, pinching, manipulating, pulling, and pushing are abilities that are required by many activities. Abilities such as mathematical reasoning, perceptual speed, and manual dexterity are required for job-related activities (Fleishman, 1972). In occupational therapy, occupations are divided into two categories, occupation-as-means and occupation-as-end. Occupation-as-means is used to improve impaired abilities, whereas occupation-as-end is an activity in which the goal is engagement in a meaningful occupation (Trombly, 2002).

Occupation-as-Means and Occupation-as-End

Occupation-as-means is used as a treatment to improve the person's impaired abilities and capacities. In this case, occupation acts as a therapeutic agent to improve one's performance. Games, sports, exercise routines, and daily activities that are selected and tailored to fit each individual's needs are used as occupation-as-means.

Occupation-as-means is beneficial when the activity has a purpose or goal that is difficult to accomplish, but still has the prospect of achievement (Trombly, 2002).

Furthermore, if it is meaningful and relevant to the values of the individual who performs the activity, it motivates the person to practice and improve. There is an assumption that if an activity is goal-oriented or purposeful, it elicits the most efficient response (Trombly, 2002). Trombly and Wu (1999) compared the movement organization in two conditions, a reaching movement with and without purpose. According to their findings, the reach was smoother, faster, and more planned when the goal was present (taking a piece of food from the plate and bringing it to the mouth) than when it was absent (reaching forward to the same place without the food), although the two movements were biomechanically equivalent.

Occupation-as-end refers to an activity that is both purposeful and meaningful. In this case, accomplishing the occupation is the goal of the occupational therapy intervention. Occupation-as-end may remediate impairments, but that is not the purpose of the occupation chosen by the therapists. Meaningfulness of occupation-as-end is based on a person's values obtained from family and culture. Meaningfulness also is derived from the person's sense of the importance of engaging in certain occupations or activities, from the

person's estimate of his or her achievement in terms of success, and possibly from undesirable consequences if the occupation is not fulfilled (Trombly, 2002).

Very few studies in occupational therapy have tested the association between

occupation-as-end and motivated behavior. However, one study found a moderate correlation ($r=0.44$) between fulfilling home management roles and overall life satisfaction among 15 individuals with spinal cord injury (Yerxa & Baum, 1986).

Occupation-as-end is implemented by teaching the activity directly. Adaptations are provided by therapists if necessary. As occupation occurs within the integration of the context, activity demands and client factors, changing any one of the elements may result in successful achievement. Among them, occupation-as-end tends to focus on modifying context and/or activity demands (AOTA, 2002).

Implementation of the Wii in Occupational Therapy

The Nintendo Wii is suitable as a therapeutic activity because it can be used as both occupation-as-means and occupation-as-end. To be used as occupation-as-means, the activity must be purposeful and meaningful (Trombly, 2002). As the Wii is a computer game, all of the games are goal oriented and thus, it is a purposeful activity. According to Trombly (2002), meaningfulness is expressed in four ways: (1) provide enjoyment; (2) offer a choice; (3) make an end product to keep; and (4) enhance the context or make the context more applicable to the person's life. Playing the Wii is an activity that may cover all of the above. It may provide enjoyment because the aim of computer games is entertainment. As more software developers create games for the Wii, there are many choices. As the data of each player is recordable on a memory device, it can provide a

personal record. As the console of the Wii is relatively small and easy to plug in to any TV, it can be set up in houses and facilities, thus a person can play the Wii in a place he or she may desire to play. Therefore, it appears that the Wii is an ideal activity to be used as occupation-as-means in various settings.

In OTPF, activities of daily living (ADL), instrumental activities of daily living (IADL), education, work, play, leisure, and social participation are seven domains that compose areas of occupation. Assuming that playing the Wii is a meaningful activity to an individual, it will be considered as occupation-as-end for that individual. Playing the Wii can be categorized in the domain of leisure or social participation depending on how an

individual uses the Wii. If he or she uses the Wii by himself or herself for enjoyment or for fitness, it will be categorized in the domain of leisure. If he or she uses the Wii with family members or friends, it will be considered as an activity for social participation. As some Wii games allow multiple players to participate in the game together, it can be used as a tool to facilitate communication in a specific group such as a senior center or a nursing facility.

Since occupation is subjective and personal, it is difficult for a therapist to find one activity that can serve as occupation to many clients. Playing the Wii may become occupation to many people because of the wide variety of Wii software. To date, the Wii software includes sports simulation games such as Wii Sports, Wii Fit, and Dance Dance Revolution, knowledge seeking activities such as Endless Ocean and role-playing games such as Dragon Quest and Super Mario Galaxy.

The level of difficulty is also modifiable by choosing games that fit a person's

functional and intellectual level. By choosing appropriate software, activity demand of the Wii can be modified to meet a client's performance skills and function. As some outdoor sports and activities require a specific environment, simulating those sports and activities with the Wii can be a safer alternative. The Wii can be available in any environment where a TV monitor and a console are placed. Currently, increasing numbers of occupational and physical therapists in hospitals and nursing facilities implement the Wii as part of their patients' treatment (Miller, 2007; Newton, 2008). Therefore, more research is needed to examine the effectiveness of this innovative activity and the impact of it on occupational therapy practice.

Physiological Changes with Aging

Physiological changes with aging are heterogeneous. Factors such as diet, physical activity, medications, and psychosocial environments can be modifiers of the aging process. It remains unclear whether the typical aging process is simply an early stage of disease without obvious clinical symptoms or whether age-related diseases are cases of accelerated aging or symptoms of distinctive diseases. Currently, it is widely believed that the aged cell

may be a favorable environment for pathological changes to occur (Timiras, 2003). The following sections describe physiological changes typically seen in older adults.

Changes in the Nervous System

Despite the persistence of central nervous system (CNS) plasticity in old age, the boundaries between health and disease become vague as the incidence of neurological and mental impairment increases. CNS disorders such as decreased sensation, balance and coordination contribute nearly half of the incidence of disability in individuals older than

65 years (Timiras, 2003). In the following section, the effects of aging on the nervous system are addressed for motor function, gait, and balance.

Posture and movement are controlled by a number of structures and functions in the CNS. With aging, skilled motor movements are slowed, and gross movements, especially those related to maintain posture and gait, are changed. These alterations impact the contractions of specific muscles resulting in abnormal movements or posture (Timiras, 2003).

Changes in Gait and Balance

With advancing age, normal gait changes to slower and shortened steps, and decreased arm swinging with increased irregularity and hesitancy in the walking pattern. Although these gait alterations are caused by decreased nerve conduction velocity, decreased muscle mass and increased muscle rigidity, relatively little is known about the mechanisms of the regulation of gait and balance. Nevertheless, by observing gait and balance, much of a person's overall physiologic capacity can be learned. Measurement of gait characteristics, such as speed and length of stride can provide useful information regarding changes to the central and peripheral nervous systems. Sensory organs such as visual, vestibular, and proprioceptive sensors convey information to the CNS, which innervates muscles of the neck, trunk, and limbs to maintain normal posture, balance, and gait. Alteration in any of these functions will reflect failure of integration of one or more CNS structures. Furthermore, impairment of gait and balance may also indicate disturbances of the musculoskeletal system (Judge, King, Whipple, Clive, & Wolfson,

In older adults, changes in gait, pain, and limitation of joint movements influence their balance. The consequence of decreased balance is an increased frequency of falls. Falls are one of the most common problems of older adults. Some falls occur without any external cause and may be due to alterations in peripheral (ocular, vestibular, and proprioceptive) and central (cerebellar and cortical) coordination, or bone fractures due to osteoporosis, especially in postmenopausal women (Cumming, Salkeld, Thomas & Szonyi, 2000). Evaluation of falls reveals that occurrences may be related to decreased reaction time, sensory input and muscle mass (Shumway-Cook & Woollacott, 2000).

Changes in the Musculoskeletal System

Bones

Maintenance of bone structure and function is a dynamic process. Bone mass is regulated throughout life by bone resorption and bone formation. Bone is always in a state of fluctuation. It constantly modifies and reappropriates its mineral stores according to mechanical stress (Timiras, 2003).

Bone strength is an important property that allows bones to tolerate the applied forces when a person makes a move. Several studies of bone strength revealed a consistent decline of bone strength with aging. A comparison of the change in strength of several musculoskeletal components with aging suggests that the fastest decline in strength is to cartilage followed by muscle, bone, and tendon (Smith, Sempos, & Purvis, 1981).

Fracture patterns in older adults differ noticeably from those in younger adults. In adults younger than 50 years of age, considerable force is needed to break bones. However, in the elderly, minimal or moderate trauma can cause bone fractures. This is due to the

progressive loss of bone volume with aging. In the elderly, fractures often occur in cancellous bones next to a joint. Orthopedic interventions to repair fractures are difficult and recovery is slower in the elderly due to bone fragility and an overall weak condition (Timiras, 2003).

Joints

There is a continual decline in joint function after age 20. Ligaments and tendons become less resilient, which make older adults more susceptible to falls. The quantity and viscosity of synovial fluid decrease with aging and the cartilage becomes nebulous with increased cracks and frays. Areas where smooth cartilage has been replaced by a rough surface occur in all joints and spread to the periphery of the joint with age. As cartilage ages, it loses elasticity and becomes more fragile. These changes cause easier fatigability and make older adults prone to osteoarthritis (Medina, 1996).

Muscles

Muscle force and power are necessary to maintain structural integrity, to uphold posture for locomotion, breathing, and for all functions of the body, including movement and participating in physical activity. Muscle strength declines in middle age, and continues to decline at a constant rate as a person ages. However, the rate of decline varies among muscle groups. For example, the diaphragm remains active throughout life and little decline with aging is observed. In contrast, the soleus muscle of the leg shows decreased strength with aging (Timiras, 2003).

Macroscopically, as muscles age, they become smaller in size due to loss of motor units. They lose the red-brown color of normal muscle due to the loss of myoglobin

pigment. Microscopically, muscle fibers decrease in number, especially fast-contracting Type II fibers. Synthesis of contractile protein is decreased and mitochondrial mass reduces with consequent decrease of muscle oxidative capacity. Along with these muscle changes, the myoneural junction experiences the following changes: the capacity to sustain transmission of the nerve impulse from the neuronal axon to the muscle fiber declines; the

amount of acetylcholine, the neurotransmitter at the neuromuscular junction, decreases; the motor nerve conduction velocity is decreased; and the balance between nerve terminal growth and deterioration becomes unstable (Timiras, 2003).

Force Control and Regulation

Since smooth and accurate movements require efficient use of force, force control is considered a fundamental component of movement production. Older adults have a reduced ability to ramp and regulate force, making it difficult to initiate and execute movements quickly and accurately in a variety of tasks (Roos, Rice, Connelly, & Vandervoort, 1999; Singh et al., 1999). Stelmach, Goggin, and Amrhein (1988) demonstrated that older adults had a reduced range of force production and larger force output variability. In addition, older adults' rate of force production was slower, as it took 20 milliseconds longer to achieve 45% of their maximum force level (15N). It has also been reported that when older adults perform isometric force tasks, they produce multiple bursts of force to achieve the targeted force level. This is in contrast to the young, who produce a single burst to the targeted level. These changes contribute to older adults' difficulty in regulation and coordination of force. Changes in force regulation and coordination have a large impact on most functional movements that require precise force generation and termination.

Coordination

With advanced age, controlling multiple movement components becomes difficult. Such evidence has been found in various movement types: aiming, reaching, grasping, and bilateral coordination tasks. Furthermore, in movements that require precise temporal regulation between the arm and shoulder, the older adults show irregular angular velocities. Ketcham, Dounskaia, and Stelmach (2004) showed that the multijoint drawing performance of older participants was not as good as that of younger participants. They concluded that qualitative differences of the drawings were a result of differences in control of movements between young and older adults. Older adults tended to keep the amplitude of the elbow constant across increasing speeds, whereas young adults increased its amplitude. Additionally, older adults decreased the phase offset between the time of shoulder and

elbow flexion and extension, whereas young adults held it constant across increasing speeds. These findings represent some of the problems older adults experience when required to control and regulate multiple joints.

Deconditioning

Deconditioning is a multifaceted process of physiological change following a period of inactivity or a sedentary lifestyle. It causes functional losses in areas such as mental status, degree of continence, and ability to carry out activities of daily living (ADL). It can occur gradually or acutely, depending upon the degree of inactivity (Gillis & Macdonald, 2005). Fiatarone and Evans (1990) identified four major contributors to deconditioning seen in older adults: the cumulative effects of acute and chronic disease resulting from immobility imposed by illnesses; increased use of medications which over

time might affect muscle metabolism and performance; disuse resulting from decreased activity level; and poor nutrition which might hinder muscle function due to specific deficiencies resulting from inadequate nutritional intake.

The symptoms of deconditioning are usually seen in the musculoskeletal system as indicated by decreased muscle mass, decreased muscle strength and endurance, muscle fiber shortening, and changes in periarticular and cartilaginous joint structure, which can seriously limit mobility (Gillis & Macdonald, 2005). The clear relationship between deconditioning and the aging process allows us to predict that promoting physically active lifestyles may also ameliorate some of the deficits and dysfunction that older people experience.

Definition of Physical Activity

Many studies have indicated that physically active lifestyles benefit individuals throughout the life span (Fiatarone & Evans, 1990; Fletcher et al., 2005; Hui & Rubenstein, 2006; Nelson et al, 2007). Physically active lifestyles improve both physiological and psychological conditions. Physiological benefits include improved: (1) cardiovascular functioning, (2) muscle strength, (3) flexibility, (4) balance and coordination, and (5) velocity of movement. These improvements may help individuals to preserve independent

living, to control specific diseases, and to minimize the possibility of certain disabilities.

Psychological benefits of physical activity include reduced stress and anxiety and enhanced relaxation and mood state (Chodzko-Zajko, 1997).

In addition to benefits for individuals, a physically active lifestyle benefits the entire society. It reduces health and social care costs, enhances the productivity of older adults,

and promotes a positive image of older people. The rising cost of health care is a concern of people in this country, and thus promoting a physically active lifestyle for people of all generations is an important public policy (Chodzko-Zajko, 1997).

Physical activity is defined as an activity that requires bodily movements produced by skeletal muscle contractions. Physical activity is composed of three subgroups: activities of daily living, occupational work, and leisure-time physical activity. Leisure-time physical activity can be further divided into sports, recreational activities, and exercise training. Sedentary lifestyle is defined as engaging in no leisure-time physical activity in more than two weeks (U.S. Department of Health and Human Services [USDHHS], 1996). To promote and maintain health, the American College of Sports Medicine (ACSM) has recommended amounts and types of physical activity for adults aged 65 and older. These include: (1) performing moderate-intensity aerobic physical activity for a minimum of 30 minutes on five days of a week or vigorous-intensity aerobic activity for a minimum of 20 minutes on three days a week and (2) performing activities that maintain or increase muscular strength and endurance for a minimum of two days a week (p.1439). Moderate-intensity aerobic activity is an activity that requires a moderate level of effort relative to an individual's aerobic fitness. On a 10-point scale, where sitting is 0 and an activity that requires maximum effort is 10, a moderate-intensity activity is an activity of 5 or 6. On the same scale, vigorous-intensity activity indicates an activity of 7 or 8. In addition, a flexibility activity and balance exercise are recommended to maintain flexibility and to reduce risk of injury from falls (Nelson et al., 2007).

Physical Activities and Older Adults

Despite the benefits of an active lifestyle, many older adults lead a less active lifestyle because of obstacles surrounding them. In addition to the age-related physiological changes described previously, factors including limited financial resources, physical and social environments, poor subjective health, functional limitations, and chronic disease can reduce activity levels of older adults (Clark, 1995). Perceived barriers, including doubts over expected benefits of exercise, fears of incurring injury or pain, and exacerbation of illness or disease, have been identified by older adults as reasons why they remain inactive (Austrian, Kerns & Reid, 2005). Nine out of ten adults older than 65 years are not active at the recommended level (Taylor, Cable, Faulkner, Hillsdon, Narici & Van Der Bij, 2004) and more than two-thirds of older adults are not doing any regular exercise (Jette et al., 1996). Our culture often views older adults as individuals who need less exercise because of the notion that individuals in late adulthood should slow down and should be less active. To the contrary, studies indicate that it is imperative to find ways to prevent and postpone morbidity of older adults (Nelson et al., 2007; Singh, 2002). Participating in physical activities is one of the best ways to maintain the physical and cognitive function of older adults (Watson, 2005).

Physical Activities to Promote Fitness

Navazio and Timiras (2003) recommended physical activities that are enjoyable so that people will continue to participate in them. There were several studies that investigated the effectiveness of leisure-type physical activities, which have hobby-like characteristics, and thus can be more enjoyable than conventional exercise, such as walking

and biking, for older adults. One study found that older adults who participated in a

gardening activity at a senior center for eight weeks had improvements in functional health and decreased depressive symptoms (Austin, Johnston, & Morgan, 2006). According to Chen, Li, Lin, Chen, Lin, and Wu (2007), older adults who practiced Tai Chi for 12 months had improved physical health (cardio-respiratory function, body flexibility, and hand grip strength) and psychological health (quality of sleep).

Li, Fisher, and Harmer (2005) investigated the effectiveness of Cobblestone mat walking, a modified version of traditional Chinese exercise, in which a person walks on a synthetic mat on which hard plastic replicas of river stones are placed randomly.

Participants who practiced the Cobblestone mat walking had greater physical function (balance, chair stands, gait, and blood pressure) than a control group who walked on a regular mat.

A study found that Hatha Yoga improved the condition of patients with hand osteoarthritis (OA) (Garfinkel, Schumacher, Husain, Levy, & Reshetar, 1994). Patients with hand OA were randomly assigned to receive either Yoga techniques or no treatment. After 8 weeks of intervention, variables including pain, tenderness, and finger motion were significantly improved in the Yoga treatment group. Another study reported that a group of participants who received Yoga posture training in combination with relaxation techniques had better measurements of cardiopulmonary status such as oxygen consumption and breathing frequency than the relaxation only group (Telles, Reddy, & Nagendra, 2000).

The Use of Computer Games as a Treatment Modality

Since the last decade, computer games have garnered attention as a treatment

modality. Jarus, Shavit, and Ratzon (2000) developed a computer-based treatment modality used for hand therapy. Through wrist pronation and supination, a participant can control a cursor of a computer game. Wrist range of motion, grip strength, edema, and the level of interest of participants who played a computer game during therapy were compared with participants who engaged in traditional treatment. The results indicated that participants who used a computer-based treatment modality were significantly more interested in the treatment than the control group. Using computer games was also found to be effective to

decrease procedural pain in children with acute burn injuries during the process of changing dressings (Das, Grimmer, Sparnon, McRae, & Thomas, 2005).

Many studies have suggested the negative association between video game activities and obesity of young adults (Stettler, Signer, & Suter, 2004; Vandewater, Shim, & Caplovitz, 2004). Recently, a few studies have focused on the possibility of using video games as an activity to promote physical fitness. O'Conner, Fitzgerald, Cooper, Thorman, and Boninger (2001) developed a device named GAME Wheels system, which enabled a manual wheelchair user to control a video game by propelling his/her wheelchair. As wheelchair propulsion is considered to be an upper extremity exercise for wheelchair users, motivating them to exercise longer and regularly is important for their fitness. The researchers found that wheelchair users who played video games for exercise by the GAME Wheels kept pushing the rim longer than the wheelchair users who did not. Physiological changes, including oxygen consumption, ventilation, and heart rate of the people who did exercise with the GAME Wheels, were significantly greater than that of people without the GAME Wheels. It was concluded that exercising while playing video games might help to

motivate manual wheelchair users.

Widman, McDonald, and Abresch (2006) investigated the effects of using a new upper extremity exercise device, which was integrated with a home video game. This device was designed to promote fitness of individuals with spina bifida. The participants of this study reported that the video game component was enjoyable and it helped them to keep motivated to exercise.

Lanningham-Foster et al. (2006) investigated the effect of activity-enhancing video games on energy expenditure of children. They compared energy expenditure of children who watched television while seated, children who played traditional video games while seated, and children who played activity-enhancing video games including the EyeToy (Sony Computer Entertainment) or Dance Dance Revolution (Konami Gaming, Inc.). The EyeToy is a video game that uses a USB camera to place a player in the game, so that the player can interact with the characters and objects in a game. Dance Dance Revolution is a

video game that uses a special floor mat as a controller, on which a player can dance in a certain manner according to the direction on a screen. By playing with the EyeToy and Dance Dance Revolution, the players' energy expenditure increased by 40% and 68% from resting values respectively, while watching television and playing typical video games increased the players' energy expenditure by 13% and 12%, respectively. They suggested that these activities might be used as an obesity prevention intervention because children tended to enjoy these games.

The Nintendo Wii

Since 2000, several new interfaces of video games have been developed in response

Effect of the Wii 21

to a demand from users who were complaining that the input systems of the video games were too complicated and confusing for the average users. They were asking for a controller that allowed a player to interact with a game in a natural and intuitive way (Consolewatcher, 2006). The EyeToy and Dance Dance Revolution were examples of a new type of controller. The Wii, Nintendo's latest home console, was released in 2006. It has a remote controller, named Wii Remote, which communicates with the console wirelessly. The Wii Remote can detect three-dimensional movement of a person who holds it so that it allows a player to move his/her body to operate a game (Allen, 2006). Recently, newspapers have reported that some hospitals use the Wii as a therapeutic activity to promote fitness and psychological well-being. Some occupational therapists in those hospitals use the Wii to motivate patients to come to therapy and move their bodies (Miller, 2007). Although using the Wii as a recreation for older adults is becoming more prevalent in senior centers and senior residential facilities, there are limited studies that have investigated the effects of the Wii on that population.

Summary of the Literature Review

A physically active lifestyle benefits individuals of all ages. It brings improvements in functional and psychological health and prevents or minimizes severity of certain diseases. Physically active lifestyles also benefit society. They help to postpone the onset of physical frailty and chronic diseases, thereby decreasing health and social care costs. As

people age, declining physical function is inevitable. However, by performing physical activity routinely, they can slow down the aging process. Having fun or enjoyment is important to keep people motivated. Several studies have explored the effectiveness of

physical activities which were designed to motivate people, including Yoga, Tai Chi, and home video games. The Nintendo Wii is the newest home video game console that requires physical movements to operate the game. In occupational therapy practice, therapists use purposeful and meaningful activities as either occupation-as-means or occupation-as-end and playing the Wii involves versatile activities, which can be used in either way. It can be considered occupation-as-means when someone's function improved because of playing the Wii and occupation-as-end when playing the Wii becomes a hobby or meaningful activity. The purpose of the present study is to determine the effects of using the Wii on physical and psychosocial function in well elderly living in a senior residence.

Research Questions

- (1) Does physical performance including strength, endurance, balance, functional movement, reaction time, and shoulder, elbow, and wrist range of motion improve after using the Wii for six weeks?
- (2) Does activity level increase after using the Wii for six weeks?
- (3) Does depression level decrease after using the Wii for six weeks?
- (4) Does perceived pain decrease after using the Wii for six weeks?
- (5) Do perceived physical and psychosocial functions improve after using the Wii for six weeks?

METHOD

Study Design

This study used a one-group pretest-posttest design. The independent variable was an exercise intervention using the Wii. The dependent variables were physical performance,

physical activity, depression, pain, and perceived improvements in physical and psychosocial status. The intervention was performed for 30 minutes, three times a week for six weeks, and was held in the recreation room of a senior residential facility.

Participants

The sample size of 20 participants was determined by a power analysis based on the study of Das, Grimmer, Sparnon, McRae, and Thomas (2005). The significance level and desired power were set as .05 and .80, respectively. A convenience sampling method was used to recruit 20 participants. All participants were recruited from an independent senior housing facility located in Western New York. It was confirmed that no one had used the Wii previously. Inclusion criteria for the present study were men and women aged 65 and older who lived independently in a senior residential community, and could walk at least 100 meters with or without minimal support from a cane or a walker. Exclusion criteria were individuals who had: cognitive deficits, contraindications or special precautions for aerobic exercise, respiratory or cardiac problems, or hospitalization or surgery in the past six months.

Instruments

Testing Instruments

Physical Performance Measures

Strength and endurance.

A handgrip dynamometer was used to measure maximal voluntary isometric grip strength of each hand. A Nicholas Manual Muscle Tester (Nicholas MMT) (Lafayette Instruments Co.) was used to measure maximal voluntary isometric strength of the

quadriceps of each leg. Nicholas MMT is a handheld device that quantifies the maximal muscle force exerted to resist an opposing force (breaking force). It measures force in kilograms. To measure quadriceps strength, the break test was applied, in which a

participant was asked to hold a limb at a point where the muscle was challenged. The examiner applied resistance manually while participants held the position and did not give way. For all isometric contractions, the participant was encouraged not to do a Valsalva maneuver to avoid increasing blood pressure. (The Nicholas Institute of Sports Medicine and Athletic Trauma, 2007).

The 6-Minute Walk test (6MWT) was used to assess walking endurance. 6MWT demonstrated strong test-retest reliability (intraclass correlation = 0.97). The participants were asked to walk, at a self-selected pace, over a measured walkway for six minutes (6MWT) to assess walking endurance. As it is self-paced, it is a good measure of functional exercise ability. The typical walk distance of people over age 65 is between 400 and 700 meters (Hamilton & Haennel, 2000).

Functional mobility and balance.

The Timed Up and Go test (TU&G) was used to assess functional mobility. TU&G is a modified version of the Get Up and Go introduced by Podsiadlo and Richardson (1991). Its intrarater and interrater reliability are 0.93 and 0.96, respectively (Schoppen, Boonstra, Groothof, de Vries, Goeken, & Eisma, 1999). To assess functional mobility, the participants, seated in a chair without arms, were asked to get up, walk around an object

placed eight feet away from them, walk back to the chair and sit down as quickly as possible. The time to complete the maneuver was recorded.

The Dynamic Gait Index (DGI) (Appendix A) was administered to measure dynamic balance. DGI was developed by Shumway-Cook and Woollacott (1995) to evaluate and document functional stability during gait activities in older adults. The DGI includes items such as walking while changing speed and turning the head, walking with pivot turn, walking over and around obstacles, and stair climbing. Intraclass correlation coefficients (ICCs) for test-retest and interrater reliability of total scores were 0.96 and 0.96 respectively, whereas reliability for single item scores ranged from 0.55 to 0.93 (Jonsson et al., 2000).

& Cattaneo, 2007). To assess dynamic balance, participants performed eight physical tasks.

First, the participants walked on a level surface. They walked at normal pace for the first five feet, walked as fast as possible for the next five feet and walked as slow as possible for the last five feet. They walked with head turned horizontally. They walked with head turned vertically. They demonstrated pivot turns. They walked over and around obstacles. Lastly, they walked up stairs.

Joint flexibility.

Joint range of motion was measured to assess flexibility of the shoulder, elbow and wrist joints. Shoulder flexion, extension, and abduction and elbow and wrist flexion and extension of each upper extremity were measured with a goniometer.

Reaction time.

Simple Reaction Time was measured by an Automatic Performance Analyzer (APA). Both light and sound stimuli were used to assess simple reaction time. To assess simple reaction time, an Automatic Performance Analyzer (APA) was used. The apparatus consists of a timer, a delivery stimulus trigger and a remote trigger to stop the stimulus, which is pressed by the participants with their finger. The investigator delivered the stimulus and the participant pressed a button as quickly as possible upon seeing or hearing the stimuli. The time was measured in milliseconds.

Physical Activity

The Yale Physical Activity Survey (YPAS) (Appendix B) was used to measure participation levels in physical activities. YPAS was developed by Dipietro, Caspersen, Ostfeld and Nadel (1993) as a survey for measuring physical activity in the older population. The YPAS is an interviewer-administered questionnaire that takes approximately 20 minutes to complete. The survey is divided into two sections. The first part of the survey contains a work, exercise, and recreational checklist to assess time spent

in activities during a typical week in the past month. The second section contains questions with categorical responses. These questions are designed to assess current participation in different types of activities such as vigorous activity, low intensity activity, and general moving about, which reflect specific dimensions of different types of physical activity. The time for each activity in the checklist is summed to create a total time summary index for each participant. This survey also estimates the energy expenditure of each subject. Time

spent is multiplied by an intensity code, which is equivalent to kilocalories per minute and then all of the kilocalories spent during the activities are summed and expressed as kilocalories per week for each subject (Dipietro, Caspersen, Ostfeld & Nadel, 1993).

Correlation coefficients between two administrations of YPAS ranged from 0.42 to 0.65 ($p = 0.0001$). The YPAS also demonstrated validity by correlating with some physiologic variables and habitual physical activity. The YPAS index of vigorous activity was moderately correlated with estimated maximal oxygen consumption ($r = 0.60$; $p = 0.003$) and the YPAS index of moving had a low correlation with body mass index ($r = -0.37$; $p = 0.06$) (Dipietro et al., 1993).

Pain

The Visual Analog Scale (VAS) (Appendix C) was used to measure perceived pain at that moment. VAS is a self-report scale for pain intensity. The scale is a 10cm line with No Pain at the left end (0 cm) and Worst Pain at the right end (10 cm). The participants were instructed to make a mark on the line that represented their pain. The distance from the left end to the mark was the participants level of pain measured in centimeters. Its psychometrics are as follows: Interrater correlations range from 0.28 to 0.72, test-retest reliability, from 0.41 to 0.58, and concurrent validity, from 0.61 to 0.90 (Bijur, Silver & Gallagher, 2001).

Depression

Depression was measured with the Center for Epidemiological Studies Depression Scale (CES-D) (Appendix D). For CES-D, the participant was asked 20 questions designed to assess perceived mood and level of functioning during the past week. Four factors are represented: (1) depressed affect, (2) positive affect, (3) somatic problems and retarded activity, and (4) interpersonal relationship problems. The responses are scored on a 4-point scale, where 0 is none of the time and 3 is most or all of the time. A higher score indicates greater symptoms of depression, weighted by frequency of depressive experience in the past week. A score of 16 is considered the cut-off point for clinical depression. CES-D has high internal consistency (0.85). Test-retest correlations range from 0.45 to 0.70 (Smarr, 2003).

Perceived Improvements in Physical and Psychosocial Status

Perceived improvements in physical and psychosocial status were measured with the semi-structured interview developed by the investigator (Appendix E). The participants perception about the Wii, including the advantages and disadvantages of the Wii and its influence on their physical and psychosocial status were collected by an interview.

Exercise Training Instrument

The Nintendo Wii was used as the exercise modality. The software used for this study was the Wii Sports, which contained five sports including tennis, golf, baseball, boxing, and bowling. The difficulty level of the games is adjusted according to each player's skill

level. The skill level ranges from 0 to 1000 and the Wii automatically calculates a player's skill level. As the player's performance improves, he or she is ranked at a higher skill level and the Wii automatically assigns an opponent with higher skill level.

Procedure

After obtaining approval from the Health Sciences Institutional Review Board (HSIRB), participants were recruited at the senior residential facility (Appendix F). Prior to baseline testing, the investigators made a presentation at the facility and explained the purpose and procedure of the study to recruit the residents. It was explained to them that the purpose of the present study was to examine the physical and psychosocial effects of the Wii on older adults and that they might receive a health benefit from this routine physical activity. Residents who agreed to join the study and whose primary physician approved participation were asked to sign an informed consent form (Appendix G).

All participants' demographic information, including age, gender, and past medical history (major diseases, surgery, and medications), were collected first. To quantify perceived pain, the participants were asked to identify the level of pain at that moment with the Visual Analog Scale. Next, the participants' functional mobility was assessed by the Timed Up and Go test. To assess dynamic balance, the participants completed the Dynamic Gait Index (DGI). Next, the participants were asked to walk, at a self-selected pace, over a measured walkway for six minutes (6MWT) to assess walking endurance. Light and sound stimuli were used to measure reaction time. To assess simple reaction time, an Automatic

Performance Analyzer (APA) was used. Two trials were performed for each light and sound stimulus and the fastest trial was used for data analysis.

Maximal voluntary isometric contractions of handgrip and quadriceps were measured with a dynamometer and the Nicholas MMT, respectively. There were two trials with each limb and the higher force was used for data analysis.

Participants were asked to complete the Yale Physical Activity Survey (YPAS) to identify current participation in physical activities. To assess depression, the participants completed the CES-D. Lastly, the investigator measured the participants' shoulder flexion, extension, and abduction and elbow and wrist flexion and extension of each upper extremity with a goniometer to assess joint flexibility. The entire test procedure took approximately 50 minutes for each participant.

Upon completion of the initial assessment, participants began their Wii training sessions for 30 minutes, three days per week for six weeks. Participants who played by themselves played for 30 minutes and participants who played with a partner played 15 minutes each. Participants were allowed to take a rest whenever they wanted. After completing six weeks of exercise, the posttest was administered using the same instruments in the same order as at the pretest. At the end of the posttest, a semi-structured interview was administered by the investigator to determine the changes in participants' perceived physical and psychosocial status.

Statistical Analysis

Descriptive statistics were calculated for demographic information including age,

gender and past medical history. In order to determine whether physical function and pain of the participants improved, pre- and posttest scores of the Visual Analog Scale, the Timed Up and Go test, the Dynamic Gait Index, the 6 Minute Walk test, the Simple Reaction Time test, quadriceps and handgrip strength, the Yale Physical Activity Survey, the Center for Epidemiological Studies-Depression Scale, and the shoulder, elbow and wrist range of motion were compared by paired t-tests. In addition, effect sizes were calculated to examine clinically significant changes. The significance level was set at an alpha level of 0.05. All statistical analyses were performed using SPSS (v.16.0).

RESULTS

Participants

Fourteen older adults participated in the pre test. Two participants stopped participating in the exercise training because of a health problem and an unknown reason.

A total of 12 participants (three men and nine women) completed the present study. The average age of participants was 87.3 yrs ($SD = 4.2$) and ranged from 80 to 94 yrs.

Demographic information for all participants is shown in Table 1.

Physical Performance

Muscle Strength and Walking Endurance

Bilateral grip and quadriceps strength were measured using the dynamometer and Nicholas Manual Muscle Tester, respectively (see Table 2). The collected data were grouped by the stronger side and weaker side. Average force on the pre and post tests of the quadriceps strength of the weaker side were 8.78 kg ($SD = 4.19$) and 10.64 kg ($SD = 3.83$), respectively. The difference was statistically significant ($p = .05$) and the effect size was .89.

Average force on the pre and post test of the grip strength of the stronger side were 16.0 kg ($SD = 7.18$) and 18.41 kg ($SD = 7.16$), respectively. The difference was statistically significant ($p = .007$) and the effect size was 1.34. Average force on the pre and post tests of the grip strength of the weaker side were 14.83 kg ($SD = 7.32$) and 16.5 kg ($SD = 6.78$), respectively. The difference was statistically significant ($p = .02$) and the effect size was 1.11.

Walking endurance was measured using the Six Minute Walk test (6MWT) (see Table 3). Average distances on pre and post test were 989.92 feet ($SD = 399.72$) and 1055.92 feet ($SD = 308.35$), respectively. The difference was not statistically significant ($p = .19$) and the effect size was .58.

Functional Mobility and Balance

Functional mobility was measured using the Timed Up and Go test (TU&G) (see Table 3). Average time on the pre and post tests were 12.92 sec ($SD = 5.64$) and 12.33 sec ($SD = 4.46$), respectively. The difference was not statistically significant ($p = .47$).

Dynamic balance was measured using the Dynamic Gait Index (DGI) (see Table 3). Average scores on the pre and post tests were 20.5 ($SD = 2.35$) and 20.75 ($SD = 2.09$), respectively. The difference was not statistically significant ($p = .69$).

Joint Flexibility

wrist flexion and extension was measured before and after the Wii intervention. Results are shown in Table 4. Although none of the results showed statistically significant improvements, left shoulder flexion ($d = .56$), right shoulder abduction ($d = .71$), right

elbow flexion ($d = .58$), left wrist flexion ($d = .73$), and right wrist extension ($d = .71$) showed relatively higher effect size.

Reaction Time

Reaction time was measured using the Automatic Performance Analyzer (APA) (see Table 3). Reaction time of each hand for light and sound stimuli were measured. Average reaction time on the pre and post tests of the right hand to the light stimulus were .29 sec ($SD = .08$) and .25 sec ($SD = .07$), respectively. The difference was not statistically significant ($p = .36$) and the effect size was .59. Average reaction time on the pre and post test of the left hand to the light stimulus were .28 sec ($SD = .08$) and .23 sec ($SD = .05$), respectively. The difference was not statistically significant ($p = .18$) and the effect size was .72. Average reaction time on the pre and post tests of the left hand to the sound stimulus were .21 sec ($SD = .03$) and .19 sec ($SD = .03$), respectively. The difference was not statistically significant ($p = .053$) and the effect size was .89.

Physical Activity

The level of physical activity was measured using the Yale Physical Activity Survey (YPAS) (see Table 3). Average scores on the pre and post tests were 15.21 ($SD = 7.5$) and 15.63 ($SD = 5.11$), respectively. The difference was not statistically significant ($p = .87$). Average energy expenditure on the pre and post tests were 4598.33 kcal ($SD = 2270.39$) and 4723.33 kcal ($SD = 1552.71$), respectively. The difference was not statistically significant ($p = .87$).

Perceived Pain

Perceived pain was measured using a Visual Analog Scale (VAS) (see Table 3).

Average scores on the pre and post tests were .95 ($SD = 2.32$) and .19 ($SD = .66$), respectively. The difference was not statistically significant ($p = .18$) and the effect size was .50.

Depression

Depression was measured using the Center for Epidemiological Studies-Depression Scale (CES-D) (see Table 3). Average scores on the pre and post tests were 6.66 ($SD = 4.61$) and 6.25 ($SD = 5.93$), respectively. The difference was not statistically significant ($p = .66$).

Perceived Improvements in Physical and Psychosocial Status

The participants' perception about the Wii, including the advantages and disadvantages of the Wii and its influence on their physical and psychosocial status were collected by a semi-structured interview after the post-test.

Question one asked participants about the advantages of exercising by using the Wii. All participants responded positively and answered that the Wii was entertaining. One person stated that the skill level rating that appeared at the end of the game was encouraging and motivating. Another person stated that once the game started, she was engaged in the game and did not realize her fatigue until the game was over. Another person stated that, although he used to enjoy tennis, he rarely plays now because he no longer drives. Also, he lost friends who used to play with him. Therefore he was glad that he was able to enjoy playing tennis again with the Wii.

Question two asked participants about the disadvantages of exercising by using the Wii. One person complained that the buttons on the controller were too numerous and small

for him to manipulate for some of the games. Another person, who was a golfer, complained that playing golf with the Wii was very different from playing actual outdoor

golf and he was frustrated because putting was different; he had to swing his wrists for putting on the Wii, which does not occur in real golf.

Question three asked participants whether their physical function improved after playing the Wii routinely. Seven of the twelve participants answered that they did not think the Wii exercise improved their physical function. One participant stated that since she exercises on a routine basis, in addition to the Wii exercise, that the Wii did not result in noticeable improvement. Three participants stated that they did not notice any physical change. Two participants stated that they noticed improvements in their physical function. One of them stated that she felt that it was easier to rise up from a seated position. The other stated that she felt her standing posture improved.

Question four asked participants about the improvement in their psychosocial function. Eight participants answered that they did not notice any psychosocial changes while four participants answered they did. Two of the four participants stated that after participating in the Wii, they noticed that their concentration improved. Another participant stated that participating in the Wii exercise gave her confidence. She stated, "Getting old means losing things that I enjoyed before. But learning how to play the Wii and seeing my skill level improve gave me new confidence." Another participant stated that she enjoyed the social aspects of the Wii. Talking with the investigators and other participants was an activity that she looked forward to and that made her feel good.

Question five asked participants if their opportunities for social interaction

improved by using the Wii. Three participants stated that their social interaction opportunities did not change and nine participants stated that their social interaction improved. Among the participants who thought their social interaction improved, five of them stated that they talked about the Wii with their family members after starting the Wii exercise. Seven participants stated that they talked about the Wii with other participants, residents, and staff at the facility. One participant stated that she started to engage in conversations with her partner after they participated in the Wii exercise. Another participant stated that her family member was motivated to purchase the Wii so that they

could exercise and play the Wii together. Also, three participants stated that they were looking forward to playing the Wii with their grandchildren.

DISCUSSION

The present study examined the effect of the Wii on physical performance, activity level, perceived pain, depression, and perceived physical, psychosocial functions, and social interaction in older adults in a senior residential facility. Five research questions were presented as follows; Does physical performance including strength, endurance, balance, functional mobility, reaction time, and shoulder, elbow, and wrist range of motion improve after using the Wii for six weeks?, Does activity level increase after using the Wii for six weeks?, Does depression level decrease after using the Wii for six weeks?, Does perceived pain decrease after using the Wii for six weeks?, and Do perceived physical and psychological functions and social interaction improve after using the Wii for six weeks?.

Physical Performance

To assess physical performance, objective measures of quadriceps and handgrip

strength, 6 Minute Walk test, Dynamic Gait Index, Timed Up and Go test, reaction time, and shoulder, elbow, and wrist range of motion were conducted. Significant differences were found for quadriceps strength on the weaker side and bilateral hand grip strength ($p < .05$). Improved bilateral handgrip strength may have been a result of performing the boxing function of the Wii sports that requires squeezing controllers with both hands. Increased quadriceps strength may be explained by the residents' general participation in the program. For example, the repetitive action of standing up from a sofa when taking a turn or walking the hallway to participate in the Wii exercise may have helped to increase quadriceps strength.

Other than those noted above, no significant differences in physical performance were found from pre to post testing. This small improvement might be explained by the participants' relatively higher physical function at baseline. Herman, Inbar-Borovsky, Brozgol, Giladi and Hausdorff (2009) administered Timed Up and Go test (TU&G) and Dynamic Gait Index (DGI) on 278 healthy community living older men and women.

According to their study, female mean scores of TU&G and DGI were 9.7 s and 22.5s, respectively (n=166, mean age=75.9) and those of men were 9.3 s and 23.2, respectively (n=112, mean age=76.8). Our participants were much older and performed some of the tests better than those in Herman's study. In the present study, female and male participants' mean ages were 84.77 and 90.33, respectively. The female participants' mean scores of Timed Up and Go were 13.95 s (pre test) and 12.8 s (post test) and male participants' mean scores were 9.8 s (pre test) and 10.943 s (post test). The female participants' mean score of DGI were 20.55 (pre test) and 20.33 (post test) and male ones

were 20.33 (pre test) and 22 (post test).

Considering the advanced age of our participants, their scores, especially of the male participants, were relatively high when they were compared with the scores of the Herman study. This may result from our participants' active lifestyles. The senior residential facility where all the participants resided provides regular exercise and recreational programs. In addition, some participants stated that they go to a gym or swimming pool outside the facility regularly to maintain their physical function. Also, they stated that they were aware of the importance of a physically active lifestyle. Therefore, due to the higher baseline, the Wii exercise was not able to have a significant impact on their physical function.

Physical Activity

Physical activity was measured by the Yale Physical Activity Survey (YPAS). According to another study, mean YPAS energy expenditure of people living in retirement homes was 2313 kcal/wk (n=36) and that of people living in the community was 8125 kcal/wk (n=51) (Harada, Chiu, King, & Stewart, 2001). In the present study, YPAS energy expenditure was 4598.33 (pre test) and 4723.33 (post test). Our result indicates that the energy expenditure of the participants of the present study was higher than that of people in retirement homes, but lower than that of people who live in the community. This is understandable because on the YPAS, none of our participants answered that they engaged in vigorous activities such as mowing the lawn, house repair, and cleaning as those were

done by the facility. The majority of the participants answered that they engaged in leisure type activities such as walking and recreation provided by the facility at least twice a week.

Therefore, our participants may be more active than those who live in retirement homes, but less than people living independently in the community.

Perceived Pain

Pain was measured by the Visual Analog Scale (VAS). Among 12 participants, only 2 stated that they had pain somewhere in their body at the time of pre test. Throughout the entire study, including the six weeks of exercise and the pre and post tests, ten participants did not have pain. For the participants who stated that they had pain, it was caused by a previous rotator cuff injury and rheumatoid arthritis. Therefore, no significant change was reflected on the scores of VAS scores.

Depression

Depression was measured by the Center for Epidemiological Study Depression Scale (CES-D). Although the mean score changed from 6.66 to 6.0 (the smaller the better), the change was not significant. Since the scores of all participants were lower than the cut off point of 16, indicating that they were not depressed, they had a relatively healthy mood status and therefore the Wii exercise was not able to improve depression.

Perceived Improvements in Physical and Psychosocial Status

A semi-structured interview was used to collect data about the participants' perceived physical and psychosocial improvements. The participants were asked about their perception of the advantages and disadvantages of the Wii exercise, their physical and psychosocial improvements, and social interaction among friends and family members.

Since the main purpose of the Wii, along with other computer games, is to provide entertainment, it is not surprising that all participants stated that the advantage of the Wii

was fun and enjoyment. Fun and enjoyment are primary motivators to participate in physical activity and finding an enjoyable physical activity is paramount for older adults to adopt a healthy lifestyle (Trombly, 2002).

The disadvantages in using the Wii, as stated by the participants, were mostly technical issues such as difficulty in manipulating the controller, seeing balls and targets on the screen, and controlling Mii (individualized and personalized characters who play sports in the Wii) in a virtual reality. Decreased visual acuity and impaired fine motor coordination are associated with aging and are frequent complaints in older adults (Timiras, 2003). Therefore, it is not surprising that many elders experience difficulty manipulating the Wii when they are in the initial learning phase. In addition, older adults may have difficulty in controlling the characters on the screen because they are less familiar with computer games than younger individuals.

Ten participants did not perceive physical improvements while two participants stated that they noticed minimal improvements. One participant stated that it became easier to rise up from a seated position after doing the Wii exercise. This participant showed substantial improvements in her scores from pre test to post test thereby confirming her perception of improved physical functioning. She improved 116% in the Six Minute Walk test, which measured walking endurance, and 452% in the quadriceps strength. In addition, another participant stated that her walking posture improved. Although her score for the Six Minute Walk test improved by 10%, there were no positive changes in the Dynamic Gait Index or Timed Up and Go test, which measured dynamic balance and functional movement, respectively.

There are various reasons why most participants did not perceive that their physical function improved with the Wii exercise program. The participants were residents of a senior community that requires them to be independent in their ADLs and IADLs. Therefore, all of the participants in this study were highly functional older adults.

Additionally, many of the participants engaged in routine exercise in the facility's fitness room. Therefore, participating in the Wii exercise did not affect the physical function of most participants.

Many of the participants also did not notice psychosocial changes. However, studies have suggested that routine physical activity reduces stress and anxiety and enhances mood state (Chodzko-Zajko, 1997; Nelson et al, 2007). In this study, the improvement might be minimal because of the limited time frame. However, participants might reap psychosocial benefits if they continue using the Wii regularly.

Changes in the level of social interaction largely depended on personal characteristics. While some of the participants were solely interested in performing exercise and preferred to come to the session when there were few people in the room, others enjoyed talking with other participants and the onlookers before and after the exercise session. According to Gaspar (2008), older adults should be encouraged to engage in an activity that enhances social interaction for their well-being. For individuals who were already socially outgoing, playing the Wii provided opportunities to increase their social interaction with other residents and staff in the facility. For individuals who were less social, playing the Wii did not improve their social interaction. Therefore, playing the Wii can be a physical activity that also enhances social interaction if a player is habitually social.

Furthermore, the Wii can provide an additional opportunity for individuals who enjoy social engagement to interact with others, which means that the Wii can become a meaningful activity if social interaction is of personal significance to the individual.

Several participants stated that their family members were motivated to purchase the Wii so that they could exercise and play the Wii together. Also, many participants stated that they were looking forward to playing the Wii with their grandchildren. Since the Wii is very popular among the younger generation, playing the Wii may be a good way for elders to increase their social interaction with the younger family members.

According to the comments from the participants, everyone stated that playing the Wii was an enjoyable experience. Although some participants noticed improvements

such as leg strength, posture, concentration, confidence, and mood, most participants did not perceive any physical or psychosocial changes. Opportunities for social interaction depended on an individual's personal characteristics. For outgoing individuals, participating in the Wii exercise increased their social interaction. However, for individuals who preferred performing exercise by themselves, the Wii exercise did not change their level of social interaction.

Benefits of the Wii Exercise

Through the six weeks of intervention, it was found that the Wii exercise was an enjoyable exercise modality for the older adults because of its recreational nature, flexibility, and universally acceptable characteristics. Many participants insisted to continue to complete the game when the 30 minute session was over. They stated that they did not realize they were very tired until the game was finished. The Wii's recreational nature also

Effect of the Wii 43

intrigued people other than our participants. Since many considered the Wii exercise as a recreation or fun activity rather than exercise, many residents of the facility who passed by the Club Room, the area where we had the Wii session, observed and cheered our participants playing the Wii. Some of them told us that they would like to join the exercise session.

Playing the Wii may increase social interaction among the peer residents and family members. Many participants stated that they talked about the Wii to their friends and family. The residents also talked about the Wii to the staff at the facility. One participant told the investigator that he was thinking of holding a Wii competition for the staff vs. the residents.

The family members who observed the Wii session showed strong interest in the Wii exercise. They told us that they were purchasing the Wii so that they could play with the participant when he or she visited their homes. For many participants, being able to perform an activity with the family, especially grandchildren, was very important and meaningful. Therefore, playing the Wii can be a meaningful activity to enhance social interaction for older adults.

Another benefit of the Wii exercise is its flexibility and adjustability. When a

person plays the Wii, the Wii automatically adjusts the skill level according to the level of the player. Therefore, the player can always play against opponents of similar skill levels, which makes the game more challenging and exciting. Also, an individual can personalize the Wii by making the Mii (a character made by the player that represents the player) and improve the Mii's skill level.

Since the Wii is one of the mass-produced computer games, it is not designed to

be used by people with special needs such as those who need rehabilitation. However, people of all generations can enjoy the Wii. Although some participants questioned the usability of the Wii remote due to their decreased vision and manual dexterity, all participants stated that they enjoyed the Wii exercise and would recommend it to their friends and family members.

Strengths and Weaknesses

The strength of the present study is the quantified effects of the Wii exercise. After six weeks of intervention, the improvements of the bilateral grip strength and quadriceps strength of the weaker side were statistically significant. In addition, there were several variables, which showed a large effect size ($d > .80$) indicating the trend for improvement over a longer training period.

Another strength is that very old adults who are living in a community participated in the present study. Despite relatively higher age (mean = 87.5 yrs), they were independent in ADL and IADL and were motivated to do exercise. 10 out of 12 participants attended all of the exercise sessions.

The weakness of the present study is not being able to isolate the effects of the Wii exercise due to the lack of a control group. Some participants went to the gym or attended other exercise programs while they participated in the Wii exercise. Short time frames and short exercise sessions may also have influenced the results. Because of the schedule of the facility, some participants were paired and, as they did not want to play the Wii at the same time on the split screen, they played one at a time for 15 minutes each. There might have been greater impact on their function if we were able to continue the Wii exercise over a

longer period of time and have the exercise session for 30 minutes for each person.

Another weakness of the present study is its relatively small sample size.

Availability of the room where the exercise sessions were held and the limited number of the devices (Wii console and TV monitor) did not allow us to have a larger sample size.

However, considering the fact that the number of regular participants who attend the exercise class held by the facility is approximately 15 people, it is reasonable that we recruited 14 participants for the present study (two were not able to complete).

CONCLUSION

According to the results of the present study, improvements in physical function (grip and quadriceps strength) and perceived social interaction were noted among the participants. Therefore, the Wii exercise can be used to maintain health and wellness of older adults in a community.

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Table 1

Physical characteristics of the 12 participants

Characteristic	Mean (SD)	Range
Age (yrs)		
Male	90.33 (4.73)	85-94
Female	84.67 (5.15)	76-92
Weight (kg)		
Male	76.96 (9.58)	68.04-87.09
Female	64.97 (10.48)	53.07-78.12
Height (cm)		
Male	176.70 (0.69)	175.3-176.5
Female	159.53 (6.64)	147.3-167.5
Medications (n)	2.3 (1.3)	0-4

Table 2

Results for muscle strength

Variable	Pre test	Post test	p	d
	Mean (SD)	Mean (SD)		
Quadriceps strength (kg)				
weaker side	8.77 (4.20)	10.64 (3.83)	.05	.89
stronger side	10.43 (4.60)	10.52 (5.22)	.93	.04
Handgrip strength (kg)				
weaker side	14.83 (7.32)	16.50 (6.78)	.02	1.11
stronger side	16.00 (7.18)	18.41 (7.16)	.00	1.34

Table 3

Means and SDs for the 6MWT, TU&G, DGI, Reaction Time, YPAS, YPAS Energy

Expenditure, VAS, CES-D

Variable		Pre test	Post test	p	d
		Mean (SD)	Mean (SD)		
6MWT (ft)		989.92 (399.72)	1055.92 (308.35)	.18	.58
TU&G (sec)		12.92 (5.65)	12.33 (4.46)	.47	.31
DGI		20.50 (2.35)	20.75 (2.09)	.69	.17
Reaction time (light) (sec)					
	right	.29 (.09)	.27 (.02)	.36	.59
	left	.27 (.08)	.24 (.05)	.18	.72
Reaction time (sound) (sec)					
	right	.22 (.04)	.23 (.05)	.58	.24

	left	.21 (.03)	.19 (.03)	.05	.89
YPAS (hrs/wk)		15.21 (7.56)	15.63 (5.12)	.86	.07
YPAS Energy expenditure (kcal/wk)		4598.33	4723.33	.87	.07

	(2270.39)	(1552.71)		
VAS (cm)	.95	.19	.24	.50
	(2.32)	(.66)		
CES-D	6.66	6.25	.66	.18
	(4.61)	(5.92)		

Note. 6MWT = Six Minute Walk Test; TU&G = Timed Up and Go test; DGI = Dynamic Gait Index; YPAS = Yale Physical Activity Survey; VAS = Visual Analog Scale; CES-D = Center for Epidemiologic Study Depression Scale

Effects of the Wii 59

Table 4

Means and SDs for Joint Range of Motion (degrees)

Variable	Pre test	Post test	p	d
	Mean (SD)	Mean (SD)		
Shoulder flexion				
right	128.50 (25.06)	130.08 (12.22)	.80	.11
left	133.17 (11.04)	129.08 (13.23)	.20	.56
Shoulder extension				
right	70.42 (15.00)	67.17 (20.63)	.60	.22
left	71.67 (10.60)	68.92 (10.24)	.41	.35

Shoulder abduction

right	104.00 (13.91)	108.67 (8.18)	.11	.71
left	105.25 (12.70)	106.58 (12.44)	.34	.40

Elbow flexion

right	146.33 (4.2)	143.75 (6.33)	.19	.58
left	144.67 (4.23)	144.67 (6.04)	.10	.00

Elbow extension

right	-3.08 (6.84)	-2.25 (4.93)	.34	.41
left	-1.42 (5.98)	-.75 (4.11)	.34	.41

Effects of the Wii 60

Wrist flexion

right	67.33 (8.15)	67.75 (6.02)	.83	.09
left	64.75 (9.10)	62.08 (7.00)	.10	.73

Wrist extension

right	52.58 (10.35)	57.25 (7.25)	.11	.71
left	57.00 (7.60)	59.33 (10.60)	.42	.34

Effects of the Wii 61

Appendix A

Dynamic Gait Index

Description:

Developed to assess the likelihood of falling in older adults. Designed to test eight facets of gait.

Equipment needed: Box (Shoebox), Cones (2), Stairs, 20' walkway, 15" wide

Completion:

Time: 15 minutes

Scoring: A four-point ordinal scale, ranging from 0-3. 0 indicates the lowest level of function and 3 the highest level of function.

Total Score = 24

Interpretation: < 19/24 = predictive of falls in the elderly

> 22/24 = safe ambulators

1. Gait level surface _____

Instructions: Walk at your normal speed from here to the next mark (20')

Grading: Mark the lowest category that applies.

- (3) Normal: Walks 20', no assistive devices, good speed, no evidence for imbalance, normal gait pattern
- (2) Mild Impairment: Walks 20', uses assistive devices, slower speed, mild gait deviations.
- (1) Moderate Impairment: Walks 20', slow speed, abnormal gait pattern, evidence for imbalance.
- (0) Severe Impairment: Cannot walk 20' without assistance, severe gait deviations or imbalance.

2. Change in gait speed _____

Instructions: Begin walking at your normal pace (for 5'), when I tell you go, walk as fast as you can (for 5').

When I tell you slow, walk as slowly as you can (for 5').

Grading: Mark the lowest category that applies.

- (3) Normal: Able to smoothly change walking speed without loss of balance or gait deviation. Shows a significant difference in walking speeds between normal, fast and slow speeds.
- (2) Mild Impairment: Is able to change speed but demonstrates mild gait deviations, or not gait deviations but unable to achieve a significant change in velocity, or uses an assistive device.
- (1) Moderate Impairment: Makes only minor adjustments to walking speed, or accomplishes a change in speed with significant gait deviations, or changes speed but has significant gait deviations, or changes speed but loses balance but is able to recover and continue walking.
- (0) Severe Impairment: Cannot change speeds, or loses balance and has to reach for wall or be caught.

3. Gait with horizontal head turns _____

Effects of the Wii 62

Instructions: Begin walking at your normal pace. When I tell you to look right, keep walking straight, but turn your head to the right. Keep looking to the right until I tell you, look left, then keep walking straight and turn your head to the left. Keep your head to the left until I tell you look straight, then keep walking straight, but return your head to the center.

Grading: Mark the lowest category that applies.

- (3) Normal: Performs head turns smoothly with no change in gait.
- (2) Mild Impairment: Performs head turns smoothly with slight change in gait velocity, i.e., minor disruption to smooth gait path or uses walking aid.
- (1) Moderate Impairment: Performs head turns with moderate change in gait velocity, slows down, staggers but recovers, can continue to walk.
- (0) Severe Impairment: Performs task with severe disruption of gait, i.e., staggers outside 15 path, loses balance, stops, reaches for wall.

4. Gait with vertical head turns _____

Instructions: Begin walking at your normal pace. When I tell you to look up, keep walking straight, but tip your head up. Keep looking up until I tell you, look down, then keep walking straight and tip your head down. Keep your head down until I tell you look straight, then keep walking straight, but return your head to the center.

Grading: Mark the lowest category that applies.

- (3) Normal: Performs head turns smoothly with no change in gait.
- (2) Mild Impairment: Performs head turns smoothly with slight change in gait velocity, i.e., minor disruption to smooth gait path or uses walking aid.
- (1) Moderate Impairment: Performs head turns with moderate change in gait velocity, slows down, staggers but recovers, can continue to walk.
- (0) Severe Impairment: Performs task with severe disruption of gait, i.e., staggers outside 15 path, loses balance, stops, reaches for wall.

5. Gait and pivot turn _____

Instructions: Begin walking at your normal pace. When I tell you, turn and stop, turn as quickly as you can to face the opposite direction and stop.

Grading: Mark the lowest category that applies.

- (3) Normal: Pivot turns safely within 3 seconds and stops quickly with no loss of balance.
- (2) Mild Impairment: Pivot turns safely in > 3 seconds and stops with no loss of balance.
- (1) Moderate Impairment: Turns slowly, requires verbal cueing, requires several small steps to catch balance following turn and stop.
- (0) Severe Impairment: Cannot turn safely, requires assistance to turn and stop.

6. Step over obstacle _____

Instructions: Begin walking at your normal speed. When you come to the shoebox, step over it, not around it, and keep walking.

Effects of the Wii 63

Grading: Mark the lowest category that applies.

- (3) Normal: Is able to step over the box without changing gait speed, no evidence of imbalance.
- (2) Mild Impairment: Is able to step over box, but must slow down and adjust steps to clear box safely.

- (1) Moderate Impairment: Is able to step over box but must stop, then step over. May require verbal cueing.
- (0) Severe Impairment: Cannot perform without assistance.

7. Step around obstacles _____

Instructions: Begin walking at normal speed. When you come to the first cone (about 6' away), walk around the right side of it. When you come to the second cone (6' past first cone), walk around it to the left.

Grading: Mark the lowest category that applies.

- (3) Normal: Is able to walk around cones safely without changing gait speed; no evidence of imbalance.
- (2) Mild Impairment: Is able to step around both cones, but must slow down and adjust steps to clear cones.
- (1) Moderate Impairment: Is able to clear cones but must significantly slow, speed to accomplish task, or requires verbal cueing.
- (0) Severe Impairment: Unable to clear cones, walks into one or both cones, or requires physical assistance.

8. Steps _____

Instructions: Walk up these stairs as you would at home, i.e., using the railing if necessary. At the top, turn around and walk down.

Grading: Mark the lowest category that applies.

- (3) Normal: Alternating feet, no rail.
- (2) Mild Impairment: Alternating feet, must use rail.
- (1) Moderate Impairment: Two feet to a stair, must use rail.
- (0) Severe Impairment: Cannot do safely.

TOTAL SCORE: ____ / 24

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Name: _____

Date: _____

Yale Physical Activity Survey for Older Adults

1. Please indicate which activities that you did during a **typical week in the last month** and tell us how many **hours per week** that you spent doing the activity.

Work Activities

Time (hrs/wk)

Shopping (e.g. grocery, clothes)

Stair climbing while carrying a load	_____
Laundry (time loading, unloading, hanging, folding only)	_____
Light housework: tidying, dusting, sweeping, collecting trash in home, polishing, indoor gardening, ironing)	_____
Heavy housework: vacuuming, mopping, scrubbing floors and walls, moving furniture, boxes or garbage cans	_____
Food preparation (10+ mins in duration): chopping, stirring, moving about to get food items, pots, pans	_____
Food service (10+ mins in duration): setting table, carrying food, serving food	_____
Dish washing (10+ mins in duration): clearing table, washing/drying dishes, putting dishes away	_____
Light home repair: small appliance repair, light home maintenance/repair	_____
Heavy home repair: painting, carpentry, washing/polishing car	_____

Yardwork

Effects of the Wii 65

Gardening: planting, weeding, digging, hoeing	_____
Lawn mowing (walking only)	_____
Clearing walks/driveway: sweeping, shoveling, raking	_____
Other: _____	_____

Caretaking

Time (hrs/wk)

Older or disabled person (lifting, pushing wheelchair)	_____
Childcare (lifting, carrying, pushing stroller)	_____

Exercise

Brisk walking (10+ mins in duration)	_____
Pool exercise, stretching, yoga	_____
Vigorous calisthenics, aerobics	_____
Cycling, exercycle	_____

Swimming (laps only) _____

Other: _____

Recreational Activities

Leisurely walking (10+ mins in duration) _____

Needlework: knitting, sewing, needlepoint, etc. _____

Dancing (mod/fast): line, ballroom, tap, square, etc. _____

Bowling, bocci _____

Effects of the Wii 66

Golf (walking to each hole only) _____

Racquet sports: tennis, racquetball _____

Billiards _____

Other: _____

Effects of the Wii 67

Answer the next set of questions considering what you have done in **the past month**.

1. About how many times during the past month did you participate in vigorous activities that lasted at least 10 minutes and caused large increases in breathing, heart rate, or leg fatigue or caused you to perspire?

Check one:

- Not at all (go to question 3)
- 1-3 times per month
- 1-2 times per week
- 3-4 times per week
- 5+ times per week
- I don't want to answer this question
- I don't know

2. About how long did you do this vigorous activity(ies) each time?

Check one:

- Not applicable
- 10-30 minutes
- 31-60 minutes
- 60+ minutes
- I don't want to answer this question
- I don't know

3. Think about the walks you have taken during the past month. About how many times per month did you walk for at least 10 minutes or more without stopping which was not strenuous enough to cause large increases in breathing, heart rate, or leg fatigue or cause you to perspire?

Check one:

- Not at all (go to question 5)
- 1-3 times per month
- 1-2 times per week
- 3-4 times per week
- 5+ times per week
- I don't want to answer this question
- I don't know

When you did this walking, for how many minutes did you do it?

Check one:

- Not applicable
- 10-30 minutes
- 31-60 minutes
- 60+ minutes
- I don't want to answer this question
- I don't know

4. About how many hours a day do you spend moving around on your feet while doing things?
Please report only the time that you are actually moving.

Check one:

- Not at all
- less than 1 hr per day
- 1 to less than 3 hrs per day
- 3 to less than 5 hrs per day
- 5 to less than 7 hrs per day
- 7+ hrs per day
- I don't want to answer this question
- I don't know

5. Think about how much time you spend standing or moving around on your feet on an average day during the past month. About how many hours per day do you stand?

Check one:

- Not at all
- less than 1 hr per day
- 1 to less than 3 hrs per day
- 3 to less than 5 hrs per day
- 5 to less than 7 hrs per day
- 7+ hrs per day
- I don't want to answer this question
- I don't know

About how many hours did you spend sitting on an average day during the past month?

Check one:

- Not at all
- less than 3 hrs
- 3 to less than 6 hrs
- 6 to less than 8 hrs
- 8+ hrs per day

_____ I don't want to answer this question
_____ I don't know

6. About how many flights of stairs do you climb up each day? (Let 10 steps = 1 flight)

_____ flights

7. Please compare the amount of physical activity that you do during other seasons of the year with the amount of activity you just reported for a typical week in the past month. For example, in the winter, do you do more or less activity than what you reported doing in the past month?

Please circle one answer for each season.

Spring A lot more A little more Same A little less A lot less Don't know

Summer A lot more A little more Same A little less A lot less Don't know

Fall A lot more A little more Same A little less A lot less Don't know

Winter A lot more A little more Same A little less A lot less Don't know

ID #:

Date:

Visual Analog Scale (VAS)

No Pain

Worst Pain

Directions: Ask the patient to indicate on the line where the pain is in relation to the two extremes. Measure from the left hand side to the mark.

From Stratton Hill C. Guidelines for Treatment of Cancer Pain: The Revised Pocket Edition of the Final Report of the Texas Cancer

Effects of the Wii 71

Council's Workgroup on Pain Control in Cancer Patients, 2nd Edition; pages 61-63. Copyright 1997, Texas Cancer Council.

Effects of the Wii 72

Appendix D

Center for Epidemiologic Studies Depression Scale (CES-D), NIMH

Below is a list of the ways you might have felt or behaved. Please tell me how often you have felt this way during the past week.

During the Past Week

	Rarely or none of the time (less than 1 day)	Some or a little of the moderate amount of time (1-2 days)	Occasionally or a moderate amount of time (3-4 days)	Most or all of the time (5-7 days)
1. I was bothered by things that usually don't bother me.				
2. I did not feel like eating; my appetite was poor.				
3. I felt that I could not shake off the blues even with help from my family or friends.				
4. I felt I was just as good as other people.				
5. I had trouble keeping my mind on what I was doing.				
6. I felt depressed.				
7. I felt that everything I did was an effort.				
8. I felt hopeful about the future.				
9. I thought my life had been a failure.				
10. I felt fearful.				
11. My sleep was restless.				
12. I was happy.				
13. I talked less than usual.				
14. I felt lonely.				
15. People were unfriendly.				
16. I enjoyed life.				
17. I had crying spells.				
18. I felt sad.				
19. I felt that people dislike me.				
20. I could not get going.				

SCORING: zero for answers in the first column, 1 for answers in the second column, 2 for answers in the third column, 3 for answers in the fourth column. The scoring of positive items is reversed. Possible range of scores is zero to 60, with the higher scores indicating the presence of more symptomatology.

Appendix E

Interview Questions

What do you like best about the Wii ?

What do you like the least about the Wii ?

Do you want to continue to use the Wii?

Do you think your ability to function in your everyday activities has improved by playing the

Wii for six weeks? If so, what area do you think have been improved?

Besides physical functioning, have you noticed any changes since using the Wii in other areas of

your life, for example: mood or disposition (what way or for an example), memory or attention

(if answer yes ask in what ways)?

Would you recommend the Wii to others who are interested in improving their health?

Do you think playing the Wii for six weeks has increased your chances of social interaction

(friends and family members)? If so, please explain how?

Appendix F

**Participate in a research study on *effects of the Wii on the physical
and psychological condition***

and play tennis, golf, baseball, bowling and boxing without going outside!!

Length of training time: 30 minutes, 3 time a week, 6 weeks

Pre and post test: 1.5 hours each

Starting from 2/10/2009

Location: Club Room

For more Information:

Contact: **Reiko Homma** rseto@buffalo.edu or

716-691-3607

Approved by The Health Science IRB

Consent to Participate in a Research Study

**Effects of the Wii on the Physical and Psychological Condition of Older Adults in a
Senior Residential Facility**

1. INVESTIGATORS CONDUCTING THE STUDY

Who will be conducting the study?

Principal Investigator: Reiko Homma, OTR

Contact: (716) 691-3607
e-mail: rseto@buffalo.edu

Faculty Sponsor: Nadine Fisher, Ed.D.
Department of Rehabilitation Science

Contact: (716) 829-6724
e-mail: nfisher@buffalo.edu

2. SOURCE OF SUPPORT

Who is sponsoring the research study?

There is not a sponsor for this study.

3. SITE OF THE RESEARCH STUDY

Where will the study be conducted?

The study will be conducted in the Asbury Pointe Retirement Community, 50 Stahl Road Getzville, NY 14068.

4. PURPOSE OF THE RESEARCH STUDY

What is the purpose of the research?

The purpose of this study is to determine the effect of the Wii on older adults by measuring reaction

Participant s Initials:

time, functional movements, hand function, coordination, balance, endurance, arm and leg strength, flexibility, physical activity level, pain and depression. The results of this study will help to understand how regular physical activity using the Wii impacts older adults physically and psychologically.

5. ELIGIBILITY

Who is being asked to participate in this research study?

You are being asked to participate because you are a healthy adult aged 65 or more.

Inclusion criteria:

- You are at least 65 years old
- You can live independently in a senior residential community
- You can walk at least 100 meters with or without minimal support from a cane
- You have no contraindications for aerobic exercise.

Exclusion criteria:

- Had a surgery or hospitalization within the last 6 months
- Have any lung problems, breathing difficulties or respiratory infections now or within the past 4 weeks
- Have moderate or severe cognitive impairment
- Have contraindications or special precautions for exercise, such as untreated hypertension, uncontrolled

diabetes, upper limb joint problems, or recent cardiovascular problems (e.g. heart attack, unstable angina, congestive heart failure).

If you have any of the exclusion criteria or do not meet all of the inclusion criteria, you will not be allowed to participate in the study.

6. PROCEDURES

What procedures will be performed for research purposes?

You will be tested initially, followed by 6 weeks of exercise using the Nintendo Wii, and then tested again following the training program. The testing protocols before and after the training will be exactly the same. We will assess your functional movements, physical activity level, muscle strength, flexibility, pain and depression before and after training with the Wii.

If you decide to take part in this research study, you will undergo the following procedures (that are not part of your standard medical care) free of charge:

Participant s Initials:

Test Protocols:

Pre-test

After you sign the informed consent, we will ask you about your demographic information, including your age, gender and past medical history.

Then you will be asked whether you have pain on your body at that moment and if you have, you will be asked to mark the level of pain on a vertical line.

We will ask you to be seated on a chair and on the word 'Go', you will stand up and walk to the line on the floor, turn around and come back to the chair.

We will observe how you walk as we ask you to (1) walk on a flat surface, (2) change the walking speed, (3) walk while you are looking to your right and then to your left, (4) walk while you are looking up and then looking down, (5) make a pivot turn after walking, (6) step over obstacles, (7) step around obstacles and (8) walk up stairs.

We will ask you to walk for 6 minutes at your comfortable pace.

We will ask you to place nine dowels in nine holes as quickly as possible.

We will ask you to press a button in response to light and sound stimuli.

We will ask you to squeeze a dynamometer and, in a seated position, we will ask you to straighten your leg while an investigator tries to push your leg in the opposite direction.

We will ask you to fill out questionnaires regarding your current participation in exercises and physical activities.

We will ask you 20 questions regarding your mood.

Lastly, we will measure your shoulder, elbow and wrist range of motion.

You will be given rest time as needed.

The entire process will take approximately 1 hour and 30 minutes.

Training Protocol:

The Wii Exercise:

Each session of the Wii Exercise will last for 30 minutes. You are required to perform the training at least 3 days per week for 6 weeks. The Wii exercise will be available in the recreation room of the Asbury Pointe Retirement Community on Mondays, Wednesdays and Fridays from 1:00pm to 4:00 pm by appointment.

You will be instructed how to use the software of the Wii Sports including golf, boxing, tennis, baseball, and bowling by the investigator. You will be supervised during the training session.

Post-test

The protocols of the post-test will be exactly the same as the pre-test.

Participant s Initials:

7. RISKS

What are the possible risks, side effects, and discomforts of this research study?

The testing and training protocols will impose a minimal level of stress on your arms and legs. You will be shown the proper body mechanics and be allowed to practice all tests and Wii games. The risk of injury when performing the testing and training protocols is minimal. Appropriate rest will be provided during the tests and the training sessions.

8. BENEFITS

What are the possible benefits from taking part in this research study?

You may or may not receive a health benefit from this routine physical activity. Benefits may include improvements in functional movements, reaction time, balance, muscle strength, flexibility, pain and mood.

9. ALTERNATIVE TREATMENT

What treatments or procedures are available if I decide not to participate in this research study?

If you participate or do not participate in this study, we will not alter your medical care or medication.

10. NEW FINDINGS

Will I be told of any new information or new risks that may be found during the course of the study?

You will be notified of any significant new developments that may cause you to change your mind about participating in the research study. At the completion of the study, we will send you a report about your participation and the general results of the study.

11. COST ASSOCIATED WITH THE RESEARCH STUDY

Will my insurance provider or I be charged for any costs of any procedures performed as part of this research study?

There are no costs to you or your insurance provider associated with this study.

Participant s Initials:

12. REIMBURSEMENT FOR MEDICAL TREATMENT

Who will pay if I am injured as a result of taking part in this research study?

Routinely, the University at Buffalo, State University of New York, its agents, or its employees do not compensate for or provide free medical care for participants in the event that any injury results from participation in a human research project. In the unlikely event that you become ill or injured as a direct result of participating in this study, you may receive medical care, but it will not be free of charge even if the injury is a direct result of your participation.

13. COMPENSATION FOR SUBJECT PARTICIPATION

Will I be paid for participating in this study?

You will not be paid for your participation in this study.

14. CONFIDENTIALITY

Who will know about my participation in this research study?

Information related to you will be treated in strict confidence to the extent provided by law. Your name will be organized by a number assigned to you so that your identity will be available only to project staff and will remain completely confidential. In order to monitor this research study, representatives from the Health Sciences Institutional Review Board, and other federal agencies such as the ORHP (Office of Human Research Protection) may inspect the research records, which may reveal your identity.

How long will this information be kept by the research group?

The data will be kept in a locked room where it will remain for approximately five years following the completion of the project.

15. FREEDOM TO WITHDRAW

Is my participation in this study voluntary?

Your participation in this study is voluntary and you may stop your participation at any time without prejudice and without affecting future health care.

Participant's Initials:

16. REMOVAL FROM STUDY

Can I be removed from the study without my consent?

It is possible that you may be removed from the research study by the researchers, if for example, you are

unable to perform the testing protocols safely, or you develop health problems. If any contraindications to exercise arise, you will also be removed from the study.

Participant s Initials:

Effects of the Wii 81

VOLUNTARY CONSENT

All of the above has been explained to me and all of my current questions have been answered. I am encouraged to ask questions about any aspects of this research study. If I have any questions in the future, I should contact:

Reiko Homma, OTR Principal Investigator

(716) 691-3607

Nadine Fisher, Ed. D. Faculty Sponsor

(716) 829-6724

Any questions I have about my rights as a research participant will be answered by the staff at the Office of the Health Sciences Institutional Review Board, University at Buffalo: (716) 829-2752.

By signing this form, I do not waive any of my legal rights.

By signing this form, I agree to participate in this research study. A signed copy of this consent form will

be given to me.

(Print) Name of Participant Signature of Participant Date

I certify that the nature and purpose, the potential benefits, and possible risks associated with participation in this research study have been explained to the above individual and that any questions about this information have been answered.

Print Name of Person Obtaining Consent Signature of Person Obtaining Consent Date
(Principal Investigator or Designee) (Principal Investigator or Designee)

I certify that the individuals named above as Participant and Person Obtaining Consent signed this document in my presence.

(Print) Name of Witness Signature of Witness Date

E.g. Validity and reliability of the Nintendo Wii Balance board for assessment of standing balance. Clinical research. A special form of applied research. Planned systematic study of any clinical technique to discover or support its therapeutic effectiveness. Centres on questions related to theory, which are directly related to practice. E.g. Effects of the Wii on the Physical and Psychosocial Condition of Older Adults in a Senior Residential Facility. Types of Research Questions. Aetiology What risk factors are associated with a particular disease? Prognosis What will happen to this person wi We tested the hypothesis that among community living older adults with relatively low and high socioeconomic status (SES), low SES is associated with both poorer emotional well-being and physical...Â SES may have disparate effects on physical function and mental health, perhaps due to different compensatory mechanisms. Key words. Aging emotional well-being physical function socioeconomic status.Â The index of ADL: A standardized measure of biological and psychosocial function. JAMA 185: 914â€“919, 1963.PubMedCrossRefGoogle Scholar. 22.