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The Effects of Line Dancing on Balance and Coordination in the Elderly

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THE EFFECTS OF LINE DANCING ON BALANCE
AND COORDINATION IN THE ELDERLY

by

Sara Welder
Bachelor of Science in Physical Therapy
University of North Dakota, 2000

An Independent Study

Submitted to the Graduate Faculty of the

Department of Physical Therapy

School of Medicine

University of North Dakota

in partial fulfillment of the requirements

for the degree of

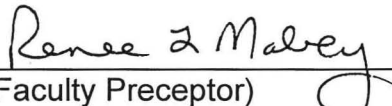
Master of Physical Therapy



Grand Forks, North Dakota

May
2001


This Independent Study, submitted by Sara Welder in partial fulfillment of the requirements for the Degree of Master of Physical Therapy from the University of North Dakota, has been read by the Faculty Preceptor, Advisor, and Chairperson of Physical Therapy under whom the work has been done and is hereby approved.



(Faculty Preceptor)



(Graduate School Advisor)



(Chairperson, Physical Therapy)

PERMISSION

Title The Effects of Line Dancing on Balance and Coordination in the Elderly

Department Physical Therapy

Degree Master of Physical Therapy

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Date 11-1-00

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ABSTRACT

The purpose of this study was to determine if a six-week line dancing program has a significant effect on balance and coordination in a geriatric population. If proven effective, line dancing can be added to the options available to physical therapists for balance and coordination training.

A total of 12 volunteer subjects participated in this study. They were separated into two groups, a control group (n = 6, 4 females and 2 males), and a dance group (n = 6, all female) according to participant's preference. Subjects were in good health, were high functioning, and were found to be at a low risk for falls. Age of subjects ranged from 72 to 94 years, with a mean age of 85.67.

The study format involved an initial and final evaluation using the Berg Balance Measure and the coordination assessment from O'Sullivan and Schmitz. Following the initial assessment, the control group was instructed to continue their normal activities during the following six-week period. The dancing group participated in a line dancing exercise program two times per week for the six weeks. Following the six-week period, the Berg Balance Measure and the coordination assessment from O'Sullivan and Schmitz were re-administered.

A Mann-Whitney U-test was used to compare the control group to the dance group using scores from both the Berg and the coordination tests. A Wilcoxon T-test was also used to compare the control group scores before versus after the

six-week period and the dancing group scores before versus after six weeks of dancing. An alpha level of $p = .05$ was used to determine significance for all tests.

At the beginning of the study, there was no significant difference between the two groups for either test ($z = -.165$, $p = .869$ for the Berg; $z = -.647$, $p = .517$ for the coordination test). Following six weeks of dancing, there was a significant difference between the control group and the dance group ($z = -2.123$, $p = .034$ for the Berg; $z = -2.500$, $p = .012$ for the coordination test). The results also demonstrated no significant change in scores in the control group ($z = -.743$, $p = .458$ for the Berg; $z = -1.289$, $p = .197$ for the coordination test), but a significant increase in the scores from the dance group following six weeks of dancing ($z = -2.14$, $p = .027$ for the Berg; $z = -2.264$, $p = .024$ for the coordination test).

A six-week line dancing program significantly improved scores on the Berg Balance Measure and the coordination assessment from O'Sullivan and Schmitz. Line dancing can be an effective tool for physical therapists to use for balance and coordination training with the elderly.

CHAPTER I

INTRODUCTION

The population of individuals age 65 and older is increasing more rapidly than any other age group.^{1,2} In 1990, the elderly population represented 12.6% of the total population in the United States, and this number is projected to rise to 22.9% by 2050.¹ In addition, the oldest old-age group (85 years and older) will increase to over 17 million by 2050, compared to 3 million in 1990.² With age comes an increased risk for falls.³ It has been reported that up to 35% of individuals in the 65 and older age group fall at least one time per year.³ Falling can result in serious injury or death and a lack of adequate balance is one of the major contributing factors behind these falls.⁴

The mechanism of balance involves the integration of information from the visual, somatosensory, and vestibular systems.^{5,6} The information must then be processed via the central nervous system (CNS) and adjustments made through the musculoskeletal system. The aging process can lead to decreased functioning in these systems resulting in a loss of balance control and an increased risk for falls.^{6,7} Therapists utilize several different techniques to improve balance in the elderly. These include strengthening, stretching, and specific balance training exercises. This study will focus on line dancing as a possible addition to the traditional balance-training program.

Problem Statement

Due to the growing number of elderly in the United States, therapists are being faced with increasingly more patients with balance deficits. There is a need to develop new and effective balance training exercises that can be utilized with the geriatric population. By incorporating activities that are perceived as recreation, patient compliance and motivation can be improved.

Purpose of Study

The purpose of this study is to determine if there is a significant improvement in balance and coordination after a six-week period of regular line dancing. If proven effective, line dancing can be added to the options available to physical therapists for balance and coordination training.

Significance of Study

Research has shown that balance control can be improved with training. This study is important because it provides information regarding the effects of line dancing on balance and coordination in a geriatric population. The use of line dancing as a tool for balance and coordination training may increase patient compliance, resulting in improved treatment outcomes.

Research Questions

1. Is there a significant change in scores on the Berg Balance Measure or the coordination test from O'Sullivan and Schmitz following six weeks of line dancing?
2. If there are significant changes, are the changes different in the control group versus the dance group?

Hypotheses

The null hypothesis is that a six-week program of line dancing will have no effect on balance or coordination scores. The alternate hypothesis is that line dancing will have a significant effect on balance and coordination scores.

CHAPTER II

LITERATURE REVIEW

The following literature review will discuss the systems involved in normal balance and how the aging process can contribute to declining function in these systems. Further, traditional balance training strategies that are currently being utilized will be presented, followed by an introduction of line dancing as an additional balance training tool.

Balance System

O'Sullivan and Schmitz define balance as "the stability produced on each side of a vertical axis."^{5(p121)} There are several different models used to explain the mechanism of balance, including the reflex/hierarchical theory, the systems theory,⁶ and the postural control theory.⁷ The basic premise behind all theories is that adequate balance requires that the center of gravity (COG) of the body be kept over the base of support during all movements. This is accomplished through a complex interaction of body systems working together to maintain balance. A body must be able to accurately acquire information through sensory mechanisms, process and interpret this information, and finally respond appropriately via the effector or musculoskeletal system.⁵⁻⁷

Sensory data are provided from the visual, vestibular, and somatosensory systems. Vision provides information about the body in relation to the external

environment and helps to vertically and horizontally orient ones self.^{7,8} The visual system sometimes provides inaccurate information regarding self versus external movement.⁶ For example, a person in a parked car may perceive a bus rolling forward in the adjacent lane as backward movement of his/her own car.

Another system providing sensory data is the vestibular system. The vestibular system is located in the inner ear and receives information about head position and movement via the semicircular canals and the otoliths.^{6,7} The semicircular canals sense fast head movements, while the otoliths are more receptive to head position in relation to gravity. Vestibular input is essential for differentiating between self versus external movement.

The final system providing sensory information critical to balance is the somatosensory system.^{6,7} The somatosensory system uses proprioceptive input from muscles, tendons, and joint receptors to detect relative orientation of body parts to supporting surfaces. It also provides information about the motion and relationship of body segments to each other.

The extent that each of these systems contributes to overall balance varies depending on the condition. It has been found that under normal circumstances, somatosensory information is weighted more heavily than visual or vestibular inputs.^{6,9} Latency of muscle response has been shown to be shorter when the trigger is somatosensory (80 to 100 msec) versus visual (200 msec).⁶ However, when proprioceptive input is disrupted, vision becomes more heavily weighted, and if both proprioceptive input and the visual system are disrupted, the vestibular system takes over.⁵ It has been shown that when the

vestibular system is the only system available, adult sway is significantly increased.¹⁰ Overall, if one of the three senses is conveying inaccurate information, then that sense is given less weight to ensure that the most appropriate sense is selected.⁶

Once the sensory information has been obtained, the central nervous system (CNS) must process this information to form a response.⁷ The CNS accomplishes this through feedback and feedforward mechanisms. When utilizing the feedback system, the body responds to a postural change attempting to bring the COG back over the base of support. With the feedforward system, the body anticipates a disruption in its COG and makes postural adjustments in advance to prevent a loss of balance from the predicted disturbance.^{7,10} It is through learned tasks that an individual develops the feedforward system. When a person is more familiar with the weight shifting and postural responses required by the task, he/she is better able to make these postural adjustments in advance. Therefore, practice involving weight shifting and COG displacements is effective for balance training.

Finally, the body must rely on the effector or the musculoskeletal component of balance when reacting to COG displacements.⁷ Range of motion, muscle strength, torque, and endurance all contribute to the ability to effectively prevent loss of balance. Nashner¹¹ describes three strategies that the body uses in order to adjust COG once it has been displaced. These include the ankle, hip, and stepping strategies. The ankle strategy is utilized with small COG displacements. With a forward COG shift, the ankle strategy involves activation

of the gastrocnemius, the hamstrings, and finally the paraspinal muscles.⁶ It requires intact range of motion (ROM) and strength in these muscles. The hip strategy is used while standing on a narrow or unsteady base of support (BOS) and involves a large amount of motion at the hip joint. With a forward COG displacement, the subject bends forward at the hip, contracting the abdominals first, followed by the quadriceps. When the COG is displaced beyond the limits of the BOS and neither the ankle nor the hip strategies are sufficient to prevent a loss of balance, the stepping strategy occurs. A step is taken forward or backward to bring the COG back over the BOS in order to regain balance.

In the elderly, there is a decline in function in these systems that are essential for balance. This can lead to reduced balance control and an increased risk for falls. These changes will be discussed in the following section.

Aging

Researchers disagree on the cause behind the decline in function commonly seen with the elderly. The premise behind the argument is whether the decline in function is due to an underlying pathology or whether it is simply a result of the aging process.^{6,7} Regardless of the cause, there are physical changes that have been shown to occur in the elderly. These changes can significantly affect balance and coordination as well as impact rehabilitation. Declining function can be due to extrinsic factors, intrinsic factors, or a combination of both.⁷ Extrinsic factors include such events as retirement, death in the family, loss of health care, or decreased activity levels. Some examples of intrinsic factors include changes in muscles, bones, joints, and nerves. Another

way of defining factors contributing to aging is to classify them as either primary or secondary.⁶ Primary factors are factors that are an inevitable result of aging, such as a genetic disposition. Secondary factors are more under the direct control of the individual, such as nutrition, exercise, and environmental conditions. It has been shown that controlling secondary factors can lead to improvements in health and an increased quality of life.⁶

The next section will discuss intrinsic factors that are affected by aging that may lead to a decline in balance and/or coordination. It is important to be aware of these factors when designing an exercise or rehabilitation program for an elderly patient. In addition, secondary factors that can be controlled should be identified so appropriate lifestyle changes can be recommended.

Intrinsic Changes Associated with Aging

As defined previously, the three main systems responsible for balance control are the sensory system, the central nervous system, and the musculoskeletal system. The process of aging affects all of these systems contributing to decreased balance control. This decreased balance control can lead to an increased risk for falls.

Sensory System

The first system that will be discussed is the sensory system. Sensory data important to balance are provided from the visual, vestibular, and somatosensory systems. Diminished function in any of the three systems can have serious effects on balance.

The visual system is largely affected by age. Peripheral vision, depth perception, dark adaptation, contrast and rod sensitivity, and pupillary responses are all diminished in the elderly.¹²⁻¹⁴ The cause may be due to cataracts, macular degeneration, glaucoma, diabetic retinopathy, or as a direct result of the aging process itself.^{6,12} Cataracts result in a clouding of the lens leading to decreased central vision, less available light, and loss of acuity.¹⁵ Macular degeneration is a condition that results in a loss of central vision, and it is the leading cause of visual impairments in people over the age of 50.^{12,15} The loss of peripheral vision, depth perception, dark adaptation, and color vision can all contribute to an increased risk for falls with community ambulation or during functional activities.

The vestibular system is also affected with age. With the use of new research methods, it has been shown that there is a significant decline in the number of both type I and type II hair cells in all vestibular organs.¹⁶ The term used to describe disorders of the vestibular system due to age is presbyastasis.⁷ Age-related changes in the vestibular system can lead to symptoms including vertigo, nystagmus, and postural imbalance. Dizziness is another possible consequence of vestibular dysfunction.⁶ Dizziness can lead to feelings of unsteadiness or imbalance which can significantly impact balance control.^{6,12} In a young adult, vestibular system deficiencies do not lead to severe balance problems due to the fact that the visual and somatosensory systems are able to compensate.⁶ However, an elderly individual may have increased difficulty adapting with other senses due to age-related decline in these systems as well as the vestibular system.

There are age-related anatomic changes that occur in peripheral receptors and afferent pathways that lead to an overall decline in somatosensory sensation in the elderly.⁷ Changes in the peripheral nervous system (PNS) include a reduction in the number of Meissner's corpuscles, a decrease in the number of peripheral nerve fibers, and a shortening of the internodal length leading to an increased conduction velocity.⁷ A study conducted by Petrella and Lattanzio¹⁷ investigated the effect of age and activity level on proprioception at the knee joint. The subjects were separated into three groups, a young group (ages 19-27), an elderly active group (ages 60-86), and an elderly inactive group (ages 60-86). The subjects were tested two times in one week for proprioceptive function. Results showed significantly decreased proprioception in the group of older subjects compared with the group of young subjects. Significantly decreased proprioception was also found in the group of inactive elderly as compared with the group of active elderly. These results suggest that there is a decline in proprioception with age and that regular exercise may help to slow this decline.

Investigators have also found that response latencies are delayed and the amplitudes of responses are more variable in older adults.¹⁰ This delayed and variable response can significantly affect the ability of an individual to adequately respond to balance disturbances resulting in increased frequency of falls. In addition, researchers agree that the lower extremities are more affected by aging than the upper extremities.⁷

Central Nervous System

Once sensory information has been received, the central nervous system (CNS) must process this information before responding via the musculoskeletal system. Age-related changes occurring in the CNS can contribute to processing delays and an insufficient postural response.¹² A research study conducted by Teasdale, Stelmach, and Breunig¹⁸ tested balance under conditions that stressed the slower, integrative mechanisms as opposed to reflexive posture control mechanisms. The purpose was to determine whether increased slowness in processing information received via the visual, somatosensory, and vestibular systems is a major cause of balance dysfunction. They found no significant differences in balance control with disruption of any one of the sensory inputs. However, a significant difference was found when both vision and somatosensory information were disrupted. These results suggest that age-related slowing of the CNS is at least partially responsible for balance dysfunction.

Researchers believe that a considerable loss of neurons occurs in the nervous system with aging.¹² One explanation for this is that neurons do not replicate. They are susceptible to damage and death throughout time, without replacement. In addition to the loss of neurons, it has been proposed that there are other factors affecting the aging brain. These include the presence of neuritic plaques, neuronal loss, slowing of nerve conduction velocities, and a decrease in the amount of neurotransmitters such as acetylcholine and

dopamine.^{7,12} Further studies are needed regarding the effects of the loss of these neurotransmitters.

Musculoskeletal System

The musculoskeletal system is responsible for carrying out motor control strategies directed by the CNS. There are several changes that the musculoskeletal system undergoes with age. One important change is the loss in muscular strength.⁷ Strength declines with age in both men and women. Muscle fibers are reduced in number and size.¹² In addition, an increase in connective tissue and fat is found in aged muscles. Research has shown a loss of quadriceps muscle strength of 10% to 22% in elderly men over a seven-year period.¹⁹ Adequate strength is necessary in order to employ balance strategies to maintain the COG over the BOS. Without the ability to employ these strategies, the likelihood of a fall increases greatly.

Another change in the musculoskeletal system that can affect balance is the loss of flexibility and joint range of motion. Collagen fibers become irregularly shaped and cross-linked with age.²⁰ This cross-linking leads to decreased mobility in the soft tissues resulting in decreased range of motion. Range of motion can also be reduced due to arthritis or pain.⁶ This loss of flexibility, along with other age-related changes including a head-forward position and dorsal kyphosis, can lead to a stooped posture which shifts the body's COG back to the heels to compensate.²¹

Significant changes also occur in the skeletal system. Changes in the articular surfaces of joints may lead to knee, hip, or ankle deformities.²¹ This

may be one explanation for the relative frequency of leg length differences found in the elderly. In addition, a loss of bone mass usually occurs as an individual ages.⁷ With decreased density, the bone is less able to resist forces and support the weight of the body. This increases the chance of injury. Although decline in bone density may not be a direct cause of loss of balance, it greatly increases the risk of fracture should a fall occur.

All of the above factors result in a decrease in postural control, or balance, in the elderly. A study by Matheson, Darlington and Smith²² found a significant increase in postural instability with increasing age and increasing difficulty of the task. In addition, the study showed that elderly males demonstrated significantly less postural control than elderly females. As postural control declines, the individual becomes less able to adapt to changing environmental conditions.

The sensory system, central nervous system, and musculoskeletal system must all work together for balance control. Aging results in declining function in all of these systems which leads to a greater risk for falls. Exercise can help to reduce this risk for falls and will be presented in the following section.

Balance Training

Traditional balance training programs involve a combination of strength and flexibility training along with balance strategy and functional training.^{6,23} It has been well documented that a regular exercise program has many beneficial effects in the elderly.²⁴⁻²⁶ These include aerobic fitness, increased strength, reduced risk for falls, and functional benefits as well as improvements in balance, mobility, and flexibility. In addition to these physical benefits, an

exercise program can lead to improved feelings of vigor,^{25,27} increased self-esteem, confidence, and self-efficacy.^{26,28} Some of the physiologic benefits include improved ventilatory function, reduced resting heart rate, decreased blood pressure, increased stroke volume, increased cardiac output, decreased cholesterol levels, and a decrease in body fat.^{23,26} In addition, an exercise program consisting of weight bearing exercises is important in the maintenance of bone strength and, therefore, a reduced risk of fractures in the elderly.²⁹ This section will focus specifically on traditional balance training exercises that attempt to improve balance strategies and motor control.

The key to balance training is repetition and practice.^{23,30} O'Sullivan and Schmitz³⁰ state that effective practice and repetition "provides appropriate feedback about sensory information, muscle recruitment, coordination, and postural patterns" as well as improving "responsiveness of postural muscles and overall balance performance."^{30(p150)} In order to demonstrate adequate balance control, an individual must be able to utilize appropriate and coordinated motor strategies in all directions and in all situations.⁶ It is essential that the individual is able to not only react to center of gravity disturbances, but also anticipate and therefore prepare for COG disturbances.

Effective balance training requires that the COG exceed the BOS in order to challenge the individual.³⁰ This will cause some degree of apprehension, but with effective education and supervision, this initial fear can be overcome. Depending on the severity of balance impairment, balance training may begin with very basic strategies.⁶ The first step is helping the individual to obtain a

symmetrical and vertical posture. This posture will provide maximal stability with the COG positioned well within the BOS. Once an acceptable vertical posture has been achieved, the individual can then work on movement strategies. These include the ankle, hip, and stepping strategies that were discussed in the previous section on balance. Strategies are first learned for recovery of balance from self-initiated COG disturbances. For example, an individual will practice swaying back and forth. When this has been accomplished, individuals must learn to develop anticipatory postural control and adapt to external COG of displacements.

Once the individual has developed the ankle, hip, and stepping strategies, he or she must learn to use these strategies functionally.⁶ This involves higher-level balance training. The goal of functional balance training is that the individual be able to modify strategies for a variety of tasks and environments so that he or she may safely perform activity-of-daily-living skills.³⁰ O'Sullivan and Schmitz³⁰ describe examples of intermediate-level balance activities. These include activities such as heel offs, toe offs, single-leg stands, marching in place, partial squats, functional reach activities, and tasks performed with a reduced BOS or with eyes closed. Some intermediate-level gait activities include gait with a narrow BOS, side-stepping with touchdown support, and wide right and left turns. When the individual is ready for high-level challenges, he or she can attempt tandem stance, lower extremity ball activities, dual-task activities in standing, and floor-to-standing transfers. Some high-level gait activities include heel-toe/tandem walking; side-stepping; crossed-step walking; 360-degree

circles; figure-eights; stopping, starting, and turning on command; toe-walking; heel-walking; and walking while talking. The Mayo Clinic health letter advocates a balance program for home use that includes single leg stance, tandem walking, and weight shifting.³¹

Balance training is an important component in an exercise program for the elderly. Keeping an individual motivated and excited about his or her exercise program is continually a challenge. The next chapter introduces line dancing as a highly motivating tool for balance training.

Dance

Line dancing is a form of movement set to music. It consists of a set number of counts that make up a sequence.³² The sequence is followed by a quarter, one-half, three-quarters, or whole turn, depending on the dance. Line dances are typically danced in a line with all dancers facing the same direction. Kudlacek said that "dancing is quite attractive for elderly females; it is easy to practice and has a low risk of accidental events and a high social benefit."^{33(p477)} Indeed, dancing is perceived as a recreational activity and is an activity with which many seniors are familiar from past experiences. There are many positive effects both psychological and physical that can be gained from dancing. Jean Watson, Ph.D. states "if one places these same institutionalized elders in a setting with music, and gives permission to dance and move their bodies, then miracles seem to happen; there appears to be a remembering that occurs at the body, mind, and soul level. . ."^{34(p119)}

The psychological benefits of an exercise program of any type have been well-documented.²⁶⁻²⁸ One important effect of dancing is a positive improvement in mood. A study that was conducted by Pierce and Pate³⁵ with older adults found that following a 75-minute session of line dancing, scores on a Profile of Mood States were significantly improved. There were significant decreases in feelings of tension, depression, fatigue and anger, and a significant increase in vigor scores.

Line dancing utilizes many of the same movement patterns that are found in traditional balance training programs that were presented in the previous section. Some of these common movements include heel offs, toe offs, single-leg stands, gait with a narrow BOS, side-stepping, quick right and left turns, tandem walking, crossed-stepped walking, 360-degree circles, stopping, starting, and turning on command. It has been shown that dancers demonstrate better center of gravity control with one leg stance as compared to non-dancers.³⁶ A study by Mouchnino et al³⁶ showed that a group of experienced dancers (mean age = 29 years) was able to reach the new required center of gravity position in only one step and was able to minimize center of gravity displacement. A group of non-dancers, on the other hand, required two steps to obtain the new position and needed significantly more adjustment time.

Dancing can also help to reduce the risk for falls. The McAuley Center in West Hartford, Conn, is a retirement community that has developed individualized exercise programs for the residents.³⁷ Group exercise programs consist of activities such as aerobics or line dancing. Of all the falls reported in

the community in the last five years, only .05% occurred among the residents who participated in the exercise program. Additionally, exercising residents report that they have increased social interactions.

An important component to line dancing is the music. Music provides the rhythm for the dance and is very motivating. In fact, music has been used on its own as a form of therapy. Music therapy has been around since the 1930s and is increasing in popularity as a means to "increase alertness and physical vigor while decreasing the isolation experienced by many geriatric patients."^{38(p1324)} Music is normally produced and stored in the right hemisphere of the brain, while language and verbal expression is concentrated in the left hemisphere.^{38,39} Many patients with aphasia or dysarthria due to left hemisphere damage have intact musical expression and can sing words of a previously learned song. Music has even been used as a means for some patients with aphasia or dysarthria to learn to communicate their basic needs. In addition, music therapy has been used to help relieve pain and insomnia, recall suppressed memories, and lower blood pressure.²⁸

Dancing and music have important physical as well as psychological effects. Line dancing in particular uses many of the same movements that have been used in traditional balance training programs and is an activity that is perceived as recreation. Balance training is becoming increasingly important as the population of elderly in this country continues to grow. Line dancing can be used as a valuable tool as part of an individual's exercise or rehabilitation program.

Summary

The mechanism of balance requires a complex interaction between the sensory system, the central nervous system, and the musculoskeletal system.⁶ The aging process can cause decreased function in these systems. This decreased function can lead to balance problems in the geriatric population. It has been shown that a regular exercise program can provide many benefits in the elderly population.²⁴⁻²⁶ One important benefit is an increase in balance control. Therapists currently utilize a variety of techniques in a clinical setting that help to improve these balance skills.

This study is proposing line dancing as a tool for balance and coordination training. Line dancing utilizes many of the same techniques used in traditional balance training programs as well as being an enjoyable and motivating activity. The purpose of this study is to determine if there is a significant improvement in balance and coordination in a geriatric population after a six-week period of line dancing.

CHAPTER III

METHODOLOGY

This project was approved by the University of North Dakota Institutional Review Board before beginning the research study (Appendix A). The procedure, benefits, and possible risks were explained to all participants. Prior to the start of the study, each subject signed an information and consent form indicating his or her voluntary participation (Appendix B). The following methodology includes subject description, instrumentation, procedure, and data analysis sections.

Subjects

A sample of convenience consisting of a total of 12 volunteer subjects was selected from Parkwood Place independent living center. For inclusion in the study, subjects were required to be over 65 years of age, living independently, and able to ambulate independently without the use of an assistive device. Subjects were excluded if they were found to be at a high risk for falls, using the Tinetti Assessment Tool.⁴⁰

The subjects were separated into two groups, a control group and a dance group according to participant's preference. The control group consisted of six subjects with ages ranging from 79 to 94 years old with a mean age of 87.5 years. Of the six subjects in the control group, four were females and two were

males. The dancing group consisted of six subjects with ages ranging from 72 to 90 years with a mean age of 83.83 years. All six of the subjects in the dancing group were female. Originally, there were nine volunteer dancers, but three of the subjects dropped out early and are not reported in the results. Of the three subjects who were lost, one moved, one died, and one developed unrelated health problems that prevented her from participating.

Instrumentation

Subjects were initially screened for fall risk using the Tinetti Assessment Tool⁴⁰ (Appendix C) and they were excluded from the study if they were found to be at a high risk for falls (score of <19). The Tinetti Assessment Tool is used to objectively analyze balance and gait and predict a person's fall risk. Subjects were scored on a three-point ordinal scale with 0 identifying the greatest impairment and 2 being the least. The total possible score is 28, with a score of >23 = low fall risk, 19-23 = increased risk for falls, and <19 high risk for falls.

All subjects that scored >19 on the Tinetti Assessment Tool were given an initial and final evaluation using the Berg Balance Measure⁴⁰ (Appendix D) and a coordination assessment from O'Sullivan and Schmitz⁵ (Appendix E). The Berg has been found to be a valid and reliable tool for assessing balance in elderly patients.⁴¹ It has been shown to have an overall interrater reliability of .98 and an intrarater reliability of .99, a very high degree of reliability. The test consists of 14 items, each scored on a five-point ordinal scale. Inability to perform the task is scored zero and a four represents independence. Total possible score is 56. The coordination assessment test consists of two parts, an equilibrium test

and a non-equilibrium test. Only the equilibrium test was performed for this study. The equilibrium test consists of 14 items, each scored on a four-point ordinal scale, for a total possible score of 56. An individual is given a score of one if the activity is impossible and a four if he or she is able to accomplish the activity. The coordination assessment test has not been tested for validity or reliability; however, it can be used as a tool to show clinical improvement.⁵ Currently, there is no standardized coordination assessment tool available.

Prior to testing, the researchers performed an inter/intrarater reliability pilot study including six volunteers. The ages of the pilot study participants ranged from 26 to 79 years of age. These volunteers were not used for the control or dance group in the line dancing study. To establish intra-rater reliability, the each researcher tested the participants two times with at least 24 hours between tests. Researchers did not have access to the initial testing results prior to the retest 24 hours later. To establish inter-rater reliability, the researchers tested the same volunteers and compared results. For all inter-rater and intra-rater correlational and reliability tests for the Tinetti, Berg, and coordination tests, the Pearson r values exceeded .967 and the ICC values exceeded .957. All tests were performed in a well-lit room with tile floors. The researchers closely guarded the subjects against falls and followed standardized protocols.

Procedure

The Tinetti Assessment Tool⁴⁰ was administered prior to the initial evaluation to screen for subjects at a high risk for falls. All subjects who scored

>19 were tested using the Berg Balance Measure⁴⁰ and the coordination assessment from O'Sullivan and Schmitz.⁵

After the initial assessment, the control group was instructed to continue their normal daily activities during the following six-week period. The dancing group participated in a thirty-minute exercise program two times per week consisting of a five-minute warm-up, 20 minutes of line dancing, and a five-minute cool down (see Appendix F for specific line dances utilized). The dancing was instructed by the researchers who were trained by an experienced line dancing instructor. The line dances were low impact, low intensity, and modified for safety. Both investigators were present during all line dancing classes, and signs and symptoms of abnormal exertion or stress were closely monitored. Subjects were instructed that they could stop at any time. Following the six-week period, the Berg Balance Measure and the coordination assessment were re-administered.

Data Analysis

The independent variable is the group in which the subject was placed, dancing or control group, and is nominal datum. The dependent variables were the scores on the Berg Balance Measure and the coordination assessment from O'Sullivan and Schmitz, and are measured on an ordinal scale. The Mann-Whitney U and Wilcoxon tests were used to analyze the data. A significance level of $p = .05$ was used to determine significance for all tests.

CHAPTER IV

RESULTS

The subject group consisted of 12 elderly volunteers, six in the control group and six in the dancing group. Table 1 lists a description of age and test scores for all subjects (n = 12).

Table 1. Description of Both Groups

Variable	Group	Mean	SD	Minimum	Maximum
Age	Combined	85.67	6.64	72.00	94.00
	Control	87.50	6.35	79.00	94.00
	Dance	83.83	6.97	72.00	90.00
Tinetti score, pre-dance	Combined	25.67	2.46	20.00	28.00
	Control	24.67	3.08	20.00	28.00
	Dance	26.67	1.21	25.00	28.00
Berg score, pre-dance	Combined	49.25	3.75	40.00	53.00
	Control	48.83	5.04	40.00	53.00
	Dance	49.67	2.25	48.00	53.00
Berg score, post-dance	Combined	51.17	4.37	42.00	56.00
	Control	48.50	4.81	42.00	54.00
	Dance	53.83	1.33	52.00	56.00
Coord. test score, pre-dance	Combined	48.67	3.96	42.00	54.00
	Control	47.67	5.47	42.00	54.00
	Dance	49.67	1.51	48.00	52.00
Coord. test score, post-dance	Combined	52.17	4.55	43.00	56.00
	Control	49.50	5.24	43.00	54.00
	Dance	54.83	.98	54.00	56.00

A total of 12 dancing sessions were offered over a six-week period. The minimum number of sessions attended was five (42%) and the maximum was 11 (92%), with an average of eight (64%).

Scores from both the Tinetti and the Berg Balance Measure were skewed to the left. This is indicative of the high functioning level of the residents who volunteered for this study.

A Mann-Whitney U-test was used to compare the control group to the dance group using scores from both the Berg Balance Measure and the coordination assessment from O'Sullivan and Schmitz (see Table 2). The results from the initial evaluation indicated no significant difference between the two groups for either test. However, following six weeks of dancing, the results indicate a significant difference between the control group and the dancing group for both the Berg and the coordination test.

Table 2. Mann-Whitney U-test: Comparison Between Control and Dance Groups

	Berg pre-dance	Berg post-dance	Coord. test pre-dance	Coord. test post-dance
Mann-Whitney U	17.00	5.00	14.00	3.00
Z	-.165	-2.123	-.647	-2.500
Significance (2-tailed test)	.869	.034	.517	.012

Another Mann-Whitney U-test was utilized to compare the change scores (post minus pretest scores) between the dance and control groups. Following six weeks of dancing, the change scores were significantly different for the Berg and

the coordination test. Results were as follows: Berg score change - $U = 4.00$, $z = -2.26$, $p = .024$; coordination score change - $U = 6.00$, $z = -2.00$, $p = .046$. The amount of change was greatest for the dance group.

A Wilcoxon T-test was used to compare the control group scores before versus after the six-week period and the dancing group scores before versus after six weeks of dancing (see Table 3). The results show no significant change in scores in the control group on either the Berg Balance Measure or the coordination assessment from O'Sullivan and Schmitz. The results do show a significant increase in both scores from the dancing group after six weeks of dancing.

Table 3. Wilcoxon T-test: Comparison of Pretest and Posttest Scores for the Berg and Coordination Tests for the Dance and Control Groups

Group	Berg		Coordination Test	
	Control	Dance	Control	Dance
Z	-.743	-2.214	-1.289	-2.264
Significance (2-tailed test)	.458	.027	.197	.024

If the scores from the Berg Balance Measure and the coordination assessment from O'Sullivan and Schmitz are considered in their raw form, results show that scores on the Berg increased by 4.17 points and scores on the coordination test increased by 5.17 points (see Table 4). As noted earlier, there was no significant change between pretests and posttests for the control group.

Table 4. Mean Scores on the Berg and the Coordination Test

	GROUP	MEAN	SD
Berg pre-dance	Control	48.83	5.04
	Dance	49.67	2.25
Berg post-dance	Control	48.50	4.81
	Dance	53.83	1.33
Coord. test pre-dance	Control	47.67	5.47
	Dance	49.67	1.51
Coord. test post-dance	Control	49.50	5.24
	Dance	54.83	.98
Berg total change	Control	-.33	2.25
	Dance	4.17	2.93
Coord. test total change	Control	1.83	2.93
	Dance	5.17	1.33

CHAPTER V

DISCUSSION

Adequate balance involves input from the sensory system, processing via the CNS, and output through the musculoskeletal system. All three of these systems are affected by age.⁶ This leads to decreased balance in the elderly, increasing the risk for falls. It is important to develop effective and practical balance training programs for the elderly to help decrease this risk for falls and subsequent injury.

The results of this study show that a six-week program of line dancing can significantly improve balance and coordination in the geriatric population. These findings are consistent with other research studies on balance exercise programs that utilize more traditional balance training techniques.^{24,42}

A study by Shumway-Cook et al²⁴ was conducted to determine if a multidimensional exercise program could improve balance and mobility function in an elderly population. All patients were given exercises intended to improve balance and mobility skills. The results showed that scores on the Berg Balance Measure increased by 8.9 points (26% improvement) in a group of fully adherent exercisers. The group of partially adherent exercisers who attended less than 75% of the exercise sessions improved by 6 points (23% improvement). Both groups showed statistically significant improvements after the exercise program.

These results are consistent with the present line dancing study in that scores on the Berg Balance Assessment improved by an average of 4.17 points in the dance group. The dance group was partially adherent and quite variable, attending between 42% and 92% of the sessions. An attempt was made to determine if age or adherence influenced test scores for this group of subjects. For this small group, neither age nor adherence influenced scores.

In addition, a study by Roberts⁴² reported the effects of a walking program on balance in an elderly population. Balance was assessed before and after six weeks of walking (30 minutes, 3x/week) using The Balance Scale. Scores were compared with a control group who received no intervention. Results show that before the six weeks, there was no significant difference in scores of the control group versus the walking group ($p = .53$); but following the six weeks, scores in the walking group were significantly higher as compared to the control group ($p = .03$).

In contrast, two studies by Crilly et al⁴³ and Lichtenstein et al⁴⁴ found no significant improvements in balance, as measured by postural sway, among elderly females following total body general exercise programs. The exercise programs included stretching, strengthening, static, dynamic, and breathing exercises for 12 and 16 weeks respectively. The design of these programs was significantly different from this line dancing study in that they focused on a more general exercise session as compared to specific balance training activities, such as line dancing.

Implications and Suggestions for Further Research

The subjects who volunteered for this line dancing study are a relatively homogeneous group in that they all reside in an independent living center and have few significant health problems. They represent a relatively old age group, with a mean age of 85.67, therefore exhibiting the normal balance deficits that accompany age. The subjects are very high functioning without significant balance or coordination problems. The dance group and the control group are very similar in ability with no significant differences found between them with any of the three balance and coordination tests performed. The fact that improvements in balance and coordination were seen in a group without significant impairments is indicative of the effectiveness of line dancing and the potential for its use in physical therapy.

The line dances, although modified for safety, do require some high-level balance activities. Therefore, the use of line dancing with a population of patients with moderate or severe balance difficulties is questionable. Further research would be helpful to investigate if line dancing would be reasonable with a lower functioning population, if proper support and accommodations were provided.

In addition to improvements in balance and coordination, line dancing can provide social, emotional, and aerobic conditioning benefits. In an informal dancing survey that was completed at the end of the six-week period, the dance group reported that they would like to continue line dancing as they felt that it was enjoyable, challenging, and provided positive social interaction. In addition,

five out of the six dancers felt that their balance was at least somewhat improved. An improvement in self-perception of balance can lead to increased confidence and independence.⁴ None of the above parameters was directly tested in this study. Further research is necessary to directly measure the aerobic conditioning effects, social and emotional benefits, and changes in self-perceptions of balance control.

Limitations

There are several limitations associated with this study. First, the participants were very active and involved with many different activities, which led to variable attendance at the dance sessions (42 - 93%). Despite this variable attendance, significant results were found, suggesting that even a limited number of dancing sessions may be sufficient to improve balance and coordination.

Second, the researchers performed both the initial and final evaluations as well as instructed the line dancing classes. Over the six-week period, a friendship between the subjects and the researchers was formed, with the subjects gaining an increased level of trust for the researchers. It is possible that this could lead to bias in the results, assuming that during the final evaluation the subjects were more willing to challenge their limits of stability due to a desire to please the researchers or because of increased confidence in the researchers. It is also possible that the researchers introduced bias in the final evaluation through their desire for the subjects to do well. This was controlled as much as

possible by following the testing protocols and not accessing the initial evaluation results at the time of the final evaluation.

Additionally, it may be argued that while a four-point improvement on the Berg and a five-point improvement on the coordination test is statistically significant, it may not be functionally relevant. With this group of high functioning subjects, an increase in score of four or five points may not have a significant effect on their functional lives. However, a patient who is lower functioning may find that an increase in four to five points is enough to increase his or her independence, therefore increasing quality of life. In addition, it is likely that scores in a lower functioning population would increase by a proportionately larger degree.

Finally, loss of subjects in this study was significant, with only six of the original nine dance subjects able to complete the six weeks. Of the three subjects who were lost, one moved, one died, and one developed unrelated health problems preventing her from participating. Future studies should keep in mind this high drop-out rate and begin with as large a sample size as possible.

Originally, it was thought that the sample size of 12 would be a limitation in that it might not be large enough to see results. However, significant results were seen even with this relatively small sample size.

Conclusion

This study shows that line dancing can be a very effective tool for improving balance and coordination in the elderly population. The growing population of elderly in this country leads to the need for increased treatment

options and preventative programs. Compliance with new exercise programs is especially difficult with the geriatric population as their daily routines have been established long ago. Line dancing is an easy and highly motivating activity that many seniors enjoy. The dances involve weight shifting, turning, and one-legged stance activities that are essential in developing balance control. Further, the dances can be specialized to the needs of the individual patient. For example, a stroke patient with difficulty turning to the right can be taught dances that involve weight shifting to the right, progressing to increasingly narrower right turns. Line dancing can also be utilized in a community setting for exercise, social interaction, and prevention of balance and coordination deficits. In conclusion, line dancing is a recreational activity that has the potential to provide numerous preventative as well as rehabilitative benefits.

APPENDIX A

EXPEDITED REVIEW REQUESTED UNDER ITEM 7 (NUMBER[S]) OF HHS REGULATIONS
 EXEMPT REVIEW REQUESTED UNDER ITEM _____ (NUMBER[S]) OF HHS REGULATIONS

UNIVERSITY OF NORTH DAKOTA HUMAN SUBJECTS REVIEW FORM
 FOR NEW PROJECTS OR PROCEDURAL REVISIONS TO APPROVED
 PROJECTS INVOLVING HUMAN SUBJECTS



Please include ALL information and check ALL blanks that apply.

PRINCIPAL

INVESTIGATOR: Sara Welder, Christa Stelmachuk, and Renee Mabey TELEPHONE: 777-2831 DATE: 2/25/00

ADDRESS TO WHICH NOTICE OF APPROVAL SHOULD BE SENT: _____

SCHOOL/COLLEGE: Medicine DEPARTMENT: Physical Therapy PROPOSED PROJECT DATES: 3/15/00-5/31/01
 (E.g., A&S, Medicine, EHD, etc.) (Month/Day/Year)

PROJECT TITLE: The Effects of Line Dancing on Balance and Coordination in the Elderly

FUNDING AGENCIES (IF APPLICABLE): _____

TYPE OF PROJECT (Check ALL that apply):

NEW PROJECT CONTINUATION RENEWAL DISSERTATION OR THESIS RESEARCH STUDENT RESEARCH PROJECT
 CHANGE IN PROCEDURE FOR A PREVIOUSLY APPROVED PROJECT

DISSERTATION/THESIS ADVISER, OR STUDENT ADVISER: Renee Mabey

PROPOSED PROJECT: INVOLVES NEW DRUGS (IND) INVOLVES NON-APPROVED USE OF DRUG INVOLVES A COOPERATING INSTITUTION

IF ANY OF YOUR SUBJECTS FALL IN ANY OF THE FOLLOWING CLASSIFICATION, PLEASE INDICATE THE CLASSIFICATION(S):

MINORS (<18 YEARS) PREGNANT WOMEN MENTALLY DISABLED FETUSES PERSONS WITH
 PRISONERS ABORTUSES UND STUDENTS (>18 YEARS)

IF YOUR PROJECT INVOLVES ANY HUMAN TISSUE, BODY FLUIDS, PATHOLOGICAL SPECIMENS, DONATED ORGANS, FETAL MATERIAL, OR PLACENTAL MATERIALS, CHECK HERE _____

IF YOUR PROJECT HAS BEEN/WILL BE SUBMITTED TO ANOTHER INSTITUTIONAL REVIEW BOARD(S), PLEASE LIST NAME OF BOARD(S): _____

Status: _____ Submitted; Date _____ Approved; Date _____ Pending

1. ABSTRACT: (LIMIT TO 200 WORDS OR LESS AND INCLUDE JUSTIFICATION OR NECESSITY FOR USING HUMAN SUBJECTS.)

Loss of balance and coordination in the elderly results in increased falls and subsequent injury. This study will investigate whether a treatment program consisting of line dancing can improve balance and coordination in the geriatric population. Line dancing is a form of movement set to music, which challenges the body's sensory system.

This study requires a group (16-20) of elderly (over 65 years of age) subjects. All subjects will initially undergo a standard balance test, a standard coordination test, and a blood pressure check. Subjects will be assigned to either a line dancing exercise group or to a control group based on subjects' preference. The exercise group will participate in a half-hour line dancing class taught by the researchers, two times per week for 6 weeks. The control group will continue their regular activities during the six-week period. Following this period, the groups will repeat the initial balance and coordination tests. Findings from the two groups will be compared using traditional descriptive and inferential statistics. The results from this study will add to the current body of knowledge regarding balance, coordination, and dance. The information will be reported in an independent study format.

PLEASE NOTE: Only information pertinent to your request to utilize human subjects in your project or activity should be included on this form. Where appropriate attach sections from your proposal (if seeking outside funding).

2. PROTOCOL: (Describe procedures to which humans will be subjected. Use additional pages if necessary. Attach any surveys, tests, questionnaires, interview questions, examples of interview questions (if qualitative research), etc., the subjects will be asked to complete.)

Recruitment: Subjects will be recruited from the Parkwood Place assisted living care center in Grand Forks, ND. A total of 16-20 subjects are required for this study.

Selection: Subjects will meet the study requirements if they are over 65 years of age, live independently, and ambulate independently without use of an assistive device. Subjects will be screened for risk of falls using the Tinetti Assessment Tool, and will be excluded if their score indicates that they are at a high risk for falls. Subjects will also be excluded if they are found to have abnormally high or uncontrolled blood pressure.

Procedures: All subjects will initially complete a standard functional balance test (The Berg), standardized equilibrium coordination testing, and have a baseline resting heart rate and blood pressure recorded. This will take approximately 45 minutes. Subjects will be assigned to either a control group or a line dancing exercise group consisting of movements that are routinely performed by individuals of the geriatric population. The exercise group will participate in a 30-minute line dancing class taught by the researchers, two times per week for 6 weeks. Each session will begin with a 5-minute warm-up and end with a 5-minute cool-down. The control group will continue with their regular activities during the six-week period. Both groups will repeat the initial balance and coordination tests at the end of the six-week period. All testing and line dancing will take place at Parkwood Place.

Informed Consent: Informed consent will be obtained through an information and consent form (see attached form). All individuals participating in this study will be competent and independent in their decision-making and will sign the consent form in relation to participation in this study.

Risk: Line dancing is a form of exercise, which challenges the balance system, therefore there is some degree of risk for personal injury. However, the investigators feel this risk is minimal, as line dancing is routinely performed by the elderly in recreational dancing and many of the same movements are also used in physical therapy treatment programs. In addition, the line dances used will be modified to insure they are low impact and low intensity. Subjects will be excluded if they are at a high risk for falls or have abnormally high blood pressure. Both investigators will be present during all line dancing classes, and signs/symptoms of abnormal exertion/stress will be closely monitored. If a subject presents with these signs or symptoms, heart rate and blood pressure will be evaluated. All subjects will be informed that they may stop activity at any time.

If an injury does occur during a line dancing class, the subject will be encouraged to receive prompt medical attention, as would a member of the general population in a similar circumstance. The subject and the subject's third party payer will provide payment for such treatment. Both researchers are certified in First Aid as well as CPR and would provide treatment as necessary and appropriate until required treatment could be obtained.

Compensation: Neither the researchers nor the subjects will receive any compensation associated with participation in the study.

3. BENEFITS: (Describe the benefits to the individual or society.)

Loss of balance and falls among the elderly is a large health care problem. This study will investigate the effects of line dancing on coordination and balance in the elderly as measured by standard balance and coordination tests. Many of the same movements that are used in line dancing are routinely utilized to increase coordination and balance as a physical therapy treatment. Many elderly men and women currently participate in and enjoy line dancing. Having line dancing as a treatment option may be a way to increase motivation and compliance for a balance and coordination program. This study will add to the body of knowledge regarding line dancing and balance and coordination.

Benefits for the individual subject include a possibility of increased balance and coordination. Also, the subjects will have increased socialization with peers and the opportunity to participate in a line dancing class at no cost.

- 4. RISKS:** (Describe the risks to the subject and precautions that will be taken to minimize them. The concept of risk goes beyond physical risk and includes risks to the subject's dignity and self-respect, as well as psychological, emotional or behavioral risk. If data are collected which could prove harmful or embarrassing to the subject if associated with him or her, then describe the methods to be used to protect the confidentiality of data obtained, debriefing procedures, storage of data, how long data will be stored (must be a minimum of three years), final disposition of data, etc.)

Line dancing is a form of exercise, which challenges the balance system, therefore there is some degree of risk for personal injury. However, the investigators feel this risk is minimal, as line dancing is routinely performed by the elderly in recreational dancing and many of the same movements are also used in physical therapy treatment programs. In addition, the line dances used will be modified to insure they are low impact and low intensity. Subjects will be excluded if they are at a high risk for falls or have abnormally high blood pressure. Both investigators will be present during all line dancing classes, and signs/symptoms of abnormal exertion/stress will be closely monitored. If a subject presents with these signs or symptoms, heart rate and blood pressure will be evaluated. All subjects will be informed that they may stop activity at any time

The subjects' names will not be used in any reports of the results of this study. Any information that is obtained in connection with this study and that can be identified with the subjects will remain confidential and will be disclosed only with their permission. All data from this study will be retained in the locked office of Renee Mabey at the UND physical therapy department for three years following completion of this study. At the end of the three-year period, all data will be disposed of.

- 5. CONSENT FORM:** Attach a copy of the **CONSENT FORM** to be signed by the subject (if applicable) and/or any statement to be read to the subject should be attached to this form. If no **CONSENT FORM** is to be used, document the procedures to be used to assure that infringement upon the subject's rights will not occur.

Describe where signed consent forms will be kept and for how long (must be a minimum of 3 years), including plans for final disposition or destruction.

All consent forms from this study will be retained in the locked office of Renee Mabey, at the UND physical therapy department for three years following completion of this study. Informed consent will be obtained through an information and consent form (see attached form). All individuals participating in this study will be competent and independent with their decision-making and will sign the consent form in relation to participation in this study.

- 6. For FULL IRB REVIEW** forward a signed original and fifteen (15) copies of this completed form, including fifteen (15) copies of the proposed consent form, questionnaires, examples of interview questions, etc. and any supporting documentation to the address below. An original and 19 copies are required for clinical medical projects. In cases where the proposed work is part of a proposal to a potential funding source, one copy of the completed proposal to the funding agency (agreement/contract if there is no proposal) must be attached to the completed Human Subjects Review Form if the proposal is non-clinical; 7 copies if the proposal is clinical medical. If the proposed work is being conducted for a pharmaceutical company, 7 copies of the company's protocol must be provided.

Office of Research & Program Development
University of North Dakota
Grand Forks, North Dakota 58202-7134

On campus, mail to: Office of Research & Program Development, Box 7134, or drop it off at Room 105 Twamley Hall.

For **EXEMPT** or **EXPEDITED REVIEW** forward a signed original, including a copy of the consent form, questionnaires, examples of interview questions, etc. and any supporting documentation to one of the addresses above. In cases where the proposed work is

part of a proposal to a potential funding source, one copy of the completed proposal to the funding agency (agreement/contract if there is no proposal) must be attached to the completed Human Subjects Review Form.

The policies and procedures on Use of Human Subjects of the University of North Dakota apply to all activities involving use of Human Subjects performed by personnel conducting such activities under the auspices of the University. No activities are to be initiated without prior review and approval as prescribed by the University's policies and procedures governing the use of human subjects.

SIGNATURES:

<u>Christa Helmachuk / Sara Weldey</u> Principal Investigator	<u>3-10-2000</u> Date
<u>Renee Malvey</u> Project Director or Student Adviser	<u>3-10-2000</u> Date
<u>Charles Zyke</u> Training or Center Grant Director	<u>3-10-2000</u> Date

(Revised 2/2000)

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REPORT OF ACTION: EXEMPT/EXPEDITED REVIEW
University of North Dakota Institutional Review Board

Date: April 3, 2000 Project Number: IRB-200004-198
Name: Sara Welder, Christa Stelmachuk, Renee Mabey Department/College: Physical Therapy
Project Title: The Effects of Line Dancing on Balance and Coordination in the Elderly


The above referenced project was reviewed by a designated member for the University's Institutional Review Board on April 20, 2000 and the following action was taken:

- Project approved. **EXPEDITED REVIEW** Category No. 4
Next scheduled review is on: April 2001
- Project approved. **EXEMPT REVIEW** Category No. _____
No periodic review scheduled unless so stated in the Remarks Section.
- Project approved **PENDING** receipt of corrections/additions. These corrections/additions should be submitted to ORPD for review and approval. **This study may NOT be started UNTIL final IRB approval has been received.** (See Remarks Section for further information.)
- Project approval **deferred**. **This study may not be started until final IRB approval has been received.** (See Remarks Section for further information.)
- Project **denied**. (See Remarks Section for further information.)

REMARKS: Any changes in protocol or adverse occurrences in the course of the research project must be reported immediately to the IRB Chairperson or ORPD.

PLEASE NOTE: Requested revisions for student proposals **MUST** include adviser's signature.

cc: R. Mabey, Adviser
Dean, Medical School



Signature of Designated IRB Member
UND's Institutional Review Board

4/20/00

Date

If the proposed project (clinical medical) is to be part of a research activity funded by a Federal Agency, a special assurance statement or a completed 310 Form may be required. Contact ORPD to obtain the required documents.

APPENDIX B

Subject Consent Form

**THE EFFECTS OF LINE DANCING ON BALANCE AND
COORDINATION IN THE ELDERLY**

Name of investigators: Sara Welder and Christa Stelmachuk, senior students from the physical therapy department at the University of North Dakota.

_____ has been asked to participate in a line dancing class, consisting of 20 minutes 2x/week for 6 weeks. The purpose of the line dancing class is to investigate whether line dancing can improve balance and coordination in the geriatric population. Line dancing is a form of movement set to music, which challenges the body's sensory system.

The requirements of the study are as follows: over 65 years of age, live independently, and ambulate independently without the use of an assistive device. If you wish to participate in this study you will be screened for risk of falls, and will be excluded if there is indication that you are at a high risk for falls. Participants will also be excluded if they are found to have abnormally high or uncontrolled blood pressure.

If you meet the requirements you will initially undergo a standard balance and coordination test, which will take about 45 minutes. You will then be assigned either to a control group or a line dancing group. The line dancing group will meet 2 times per week for about 30 minutes for 6 weeks. The control group will continue with their regular activities during the 6 week period. Both groups will complete the initial balance and coordination tests at the end of the 6 week period. The results of these tests will be recorded and will be available to you at any time.

The investigators feel the risk for injury is minimal as the line dances used will be modified to insure they are low impact and low intensity. Both investigators will be present during all line dancing classes, and signs/symptoms of abnormal exertion/stress will be closely monitored. If you present with these signs or symptoms, your heart rate and blood pressure will be evaluated. Participants may stop activity at any time.

If an injury does occur during a line dancing class, you will be encouraged to receive prompt medical attention, as would a member of the general population in a similar circumstance. You and your health insurance organization will provide payment for such treatment. Both researchers are certified in First Aid as well as CPR and would

provide treatment as necessary and appropriate until required treatment could be obtained.

Benefits of participating in the line dancing group include a possibility of increased balance and coordination.

Your name will not be used in any reports of the results of this study. Any information that is obtained in connection with this study and that can be identified to you will remain confidential and will be disclosed only with your permission. All data from this study will be retained in the locked office of Renee Mabey at the UND physical therapy department for three years following completion of this study. At the end of the three-year period, all data will be disposed of.

Neither the researchers nor the participants will receive any compensation associated with involvement in the study.

Participation in this study is entirely voluntary, and you may withdraw consent and discontinue participation at any time until the final data has been collected, without prejudice.

The investigators may be reached at the University of North Dakota department of physical therapy at (701)777-2831, or at home at (701)746-6069 to answer any questions concerning the study, the procedures, and/or any risks or benefits that may arise from participation in the study.

I understand all of the above information, all of my questions have been answered, and I am voluntarily agreeing to participate in the line dancing program being conducted by Sara Welder and Christa Stelmachuk from the UND physical therapy department. A copy of the consent form has been given to me.

_____	Date: _____
Signature of Subject	
_____	Date: _____
Signature of Investigators	
_____	Date: _____
Signature of Witness	

Thank you for your time and cooperation!!

APPENDIX C

TINETTI ASSESSMENT TOOL

Gait Tests

Initial Instructions: Subject stands with examiner, walks down hallway or across room, first at "usual" pace, then back at "rapid, but safe" pace (using usual walking aids)

10. Initiation of gait (immediately after told to "go")	Any hesitancy or multiple attempts to start	= 0	
	No hesitancy	= 1	
11. Step length and height			
	a. Right swing foot		
	does not pass right stance foot with step	= 0	
	passes right stance foot	= 1	
	right foot does not clear floor completely with step	= 0	
	left foot completely clears floor	= 1	
	b. Left swing foot		
	does not pass right stance foot with step	= 0	
	passes right stance foot	= 1	
	left foot does not clear floor completely with step	= 0	
	left foot completely clears floor	= 1	
12. Step Symmetry			
	Right and left step length not equal (estimate)	= 0	
	Right and left step appear equal	= 1	
13. Step Continuity			
	Stopping or discontinuity between steps	= 0	
	Steps appear continuous	= 1	
14. Path (estimated in relation to floor tiles, 12-inch diameter; observe excursion of 1 foot over about 10 ft. of the course)			
	Marked deviation	= 0	
	Mild/moderate deviation or uses walking aid	= 1	
	Straight without walking aid	= 2	
15. Trunk			
	Marked sway or uses walking aid	= 0	
	No sway but flexion of knees or back or spread arms out while walking	= 1	
	No sway, no flexion, no use of arms, and no use of walking aid	= 2	
16. Walking stance			
	Heels apart	= 0	
	Heels almost touching while walking	= 1	
Gait Score:	<u> /12 </u>		
Balance + Gait Score:	<u> /28 </u>		

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TINETTI ASSESSMENT TOOL

Balance Tests

Initial Instructions: Subject is seated in hard, armless chair. The following maneuvers are tested.

1. Sitting balance			
	Leans or slides in chair	= 0	
	Steady, safe	= 1	_____
2. Arises			
	Unable without help	= 0	
	Able, uses arms to help	= 1	Able
without using arms		= 2	_____
3. Attempts to arise			
	Unable without help	= 0	
	Able, requires > 1 attempt	= 1	
	Able to arise, 1 attempt	= 2	_____
4. Immediate standing balance (first five seconds)			
	Unsteady (swaggers, moves feet, trunk sway)	= 0	
	Steady but uses walker or other support	= 1	
	Steady without walker or other support	= 2	_____
5. Standing balance			
	Unsteady	= 0	
	Steady but wide stance (medial heels > 4 in. apart) and uses cane or other support	= 1	
	Narrow stance without support	= 2	_____
6. Nudged (subject at max. position with feet as close together as possible, examiner pushes lightly on subject's sternum with palm of hand 3 times)			
	Begins to fall	= 0	
	Staggers, grabs, catches self	= 1	
	Steady	= 2	_____
7. Eyes closed (at maximum position No. 6)			
	Unsteady	= 0	
	Steady	= 1	_____
8. Turning 360 degrees			
	Discontinuous steps	= 0	
	Continuous	= 1	
	Unsteady (grabs, staggers)	= 0	
	Steady	= 1	_____
9. Sitting down			
	Unsafe (misjudged distance, falls into chair)	= 0	
	Uses arms or not a smooth motion	= 1	
	Safe, smooth motion	= 2	_____

Balance score: _____ /16

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APPENDIX D

BALANCE SCALE

Name _____

Date _____

Location _____

Rater _____

ITEM DESCRIPTION

SCORE (0-4)

- | | |
|--|---|
| <ol style="list-style-type: none"> 1. Sitting to standing 2. Standing unsupported 3. Sitting unsupported 4. Standing to sitting 5. Transfers 6. Standing with eyes closed 7. Standing with feet together 8. Reaching forward with outstretched arm 9. Retrieving object from floor 10. Turning to look behind 11. Turning to 360 degrees 12. Placing alternate foot on stool 13. Standing with one foot in front 14. Standing on one foot | <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> |
|--|---|

TOTAL _____

GENERAL INSTRUCTIONS

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

In most items, the subject is asked to maintain a given position for specific time. Progressively more points are deducted if the time or distance requirements are not met, if the subject's performance warrants supervision, or if the subject touches an external support or receives assistance from the examiner. Subjects should understand that they must maintain their balance while attempting the tasks. The choices of which leg to stand on or how far to reach are left to the subject. Poor judgment will adversely influence the performance and the scoring.

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

1. SITTING TO STANDING

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

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

2. STANDING UNSUPPORTED

INSTRUCTIONS: Please stand for two minutes without holding.

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

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

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

INSTRUCTIONS: Please sit with arms folded for 2 minutes.

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

4. STANDING TO SITTING

INSTRUCTIONS: Please sit down.

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

5. TRANSFERS

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

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

6. STANDING UNSUPPORTED WITH EYES CLOSED

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

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

7. STANDING UNSUPPORTED WITH FEET TOGETHER

INSTRUCTIONS: Place your feet together and stand without holding.

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

8. REACHING FORWARD WITH OUTSTRETCHED ARM WHILE STANDING

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

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

9. **PICK UP OBJECT FROM THE FLOOR FROM A STANDING POSITION**
INSTRUCTIONS: Pick up the shoe/slipper which is placed in front of your feet.
 4 able to pick up slipper safely and easily
 3 able to pick up slipper but needs supervision
 2 unable to pick up but reaches 2-5 cm (1-2 inches) from slipper and keeps balance independently
 1 unable to pick up and needs supervision while trying
 0 unable to try/needs assist to keep from losing balance or falling
10. **TURNING TO LOOK BEHIND OVER LEFT AND RIGHT SHOULDERS WHILE STANDING**
INSTRUCTIONS: Turn to look directly behind you over toward left shoulder. Repeat to the right. Examiner may pick an object to look at directly behind the subject to encourage a better twist turn.
 4 looks behind from both sides and weight shifts well
 3 looks behind one side only other side shows less weight shift
 2 turns sideways only but maintains balance
 1 needs supervision when turning
 0 needs assist to keep from losing balance or falling
11. **TURN 360 DEGREES**
INSTRUCTIONS: Turn completely around in a full circle. Pause. Then turn a full circle in the other direction.
 4 able to turn 360 degrees safely in 4 seconds or less
 3 able to turn 360 degrees safely one side only 4 seconds or less
 2 able to turn 360 degrees safely but slowly
 1 needs close supervision or verbal cuing
 0 needs assistance while turning
12. **PLACE ALTERNATE FOOT ON STEP OR STOOL WHILE STANDING UNSUPPORTED**
INSTRUCTIONS: Place each foot alternately on the step/stool. Continue until each foot has touched the step/stool four times.
 4 able to stand independently and safely and complete 8 steps in 20 seconds
 3 able to stand independently and complete 8 steps > 20 seconds
 2 able to complete 4 steps without aid with supervision
 1 able to complete > 2 steps needs minimal assist
 0 needs assistance to keep from falling/unable to try
13. **STANDING UNSUPPORTED ONE FOOT IN FRONT**
INSTRUCTIONS: (DEMONSTRATE TO SUBJECT) Place one foot directly in front of the other. If you feel that you cannot place your foot directly in front, try to step far enough ahead that the heel of your forward foot is ahead of the toes of the other foot. (To score 3 points, the length of the step should exceed the length of the other foot and the width of the stance should approximate the subject's normal stride width)
 4 able to place foot tandem independently and hold 30 seconds
 3 able to place foot ahead of other independently and hold 30 seconds
 2 able to take small step independently and hold 30 seconds
 1 needs help to step but can hold 15 seconds
 0 loses balance while stepping or standing
14. **STANDING ON ONE LEG**
INSTRUCTIONS: Stand on one leg as long as you can without holding.
 4 able to lift leg independently and hold > 10 seconds
 3 able to lift leg independently and hold 5-10 seconds
 2 able to lift leg independently and hold = or > 3 seconds
 1 tries to lift leg unable to hold 3 seconds but r remains standing independently
 0 unable to try or needs assist to prevent fall
- TOTAL SCORE** (Maximum = 56)

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APPENDIX E

PART II EQUILIBRIUM TESTS

Key to Grading

4. Able to accomplish activity.
3. Can complete activity; minor physical contact guarding required to maintain balance.
2. Can complete activity; significant (moderate to maximal) contact guarding required to maintain balance.
1. Activity impossible.

Grade	Coordination Test	Comments
	Standing: normal comfortable posture	
	Standing: normal comfortable posture with vision occluded	
	Standing: feet together	
	Standing on one foot	seconds L(); R()
	Standing: forward trunk flexion and return to neutral	
	Standing: lateral trunk flexion	
	Walk: place heel of one foot in front of toe of the opposite foot	
	Walk: along a straight line	

Grade	Coordination Test	Comments
	Walk: place feet on floor markers	
	Walk: sideways	
	Walk: backward	
	Walk: in a circle	
	Walk: on heels	
	Walk: on toes	

Additional comments:

NOTE: Notations should be made under comments section if

1. Lack of visual input renders activity impossible or alters quality of performance.
2. Verbal cuing is required to accomplish activity.
3. Alterations in speed affect quality of performance.
4. An excessive amount of time is required to complete activity.
5. Changes in arm position influence equilibrium tests.
6. Any extraneous movements, unsteadiness, or oscillations are noted in head, neck, or trunk.
7. Fatigue alters consistency of response.

APPENDIX F

LINE DANCE INSTRUCTIONS

Dancers should form lines facing the same direction. Music should include a four count beat. Everyone should start on the same foot at the same time. Repeat dance sequence until the music ends.

SUNNY MOOD

Palomino records@att.net

Basic right (step right, left touch, right step, left touch)
 Basic left (step left, right touch, step left, right touch)
 Walk forward 4 steps
 Vine to the right (step right, left behind right, step right left to right)
 Vine left - same as above
 Vine right
 Vine left
 Strut 4 (heel walking) - going in semi circle - end facing the opposite direction

ALLEY CAT

Record No. 45-6226 (Golden Oldie)
 Atco Records
 Palominorecords@att.net

Vine right
 Vine left
 Go forward 3, starting with right foot
 Turn 1/4 with right foot, doing a little hitch with left foot
 Going backward starting with left foot - 4 counts
 Start vine again with right foot - dance continues.

ELVIRA

Released: 07/10/1990
 MCA Records

Vine right
 Vine left
 Go backwards 3 steps - right, left, right and forward on left
 Rock left, rock right back, rock left forward
 1/4 turn to left - dance starts again.

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