EFFECTS OF RECREATIONAL THERAPY BALANCE EXERCISE PROGRAM IN INDIVIDUALS WITH PARKINSON'S DISEASE AS PART OF A MULTIDISCIPLINARY TREATMENT: A SECONDARY DATA ANALYSIS STUDY ON FALL RISK AND DISEASE SEVERITY

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Abstract: INTRODUCTION: Parkinson's disease (PD) is a neurodegenerative disease which produces motor symptoms that increase the fall risk those individuals. This secondary data analysis studies what impact does a 16-week dual treatment featuring Recreational Therapy guided Balance Training and Speech Pathologist guided LOUD Crowd® treatment session have on an individual's fall risk and disease severity.
REVIEW OF LITERATURE: Limited research has been conducted on the benefits of a Recreational Therapist led group exercise intervention for this population. Research has shown positive outcomes with exercise with participants who have PD such as improved functional mobility, balance, strength, gait performance, and improving scores on PD rating scales. Research into community-based programming has been found to be beneficial for geriatric populations, including those with PD and other special populations. Specific research into group exercise with individuals with PD has found to possibly produce benefits in balance, gait, strength, and dual-task performance.
METHODOLOGY: Weekly 90 minute co-treatment sessions, with each treatment being 45 minutes long. Recreational Therapy focus was to maintain and improve balance, postural stability, and overall physical functioning while the Speech Pathology focus was to maintain and improve voice production, voice volume, and cognitive functioning. Baseline data was collected and compared to post data at the end of the 16-week program.
FINDINGS: Pre and Post differences in BBS Fall Risk, z=-.271(p=.786) and H&Y Scale, z=-.557(p=.577) and median differences of -0.0333 (BBS Fall Risk) and -0.1667 (H&Y Scale). No significance was observed in statistical analysis.
CONCLUSION: PD is a neurodegenerative disease with an average of 2-3 years per stage on the H&Y Scale. Results support the usage of recreational therapy to deliver treatment options that could complement existing pharmacological and behavior modification treatments for those diagnosed with PD. No significant change with PD population should be view positively and results highlight the need for longitudinal studies of similar methodology to observe long term effects against average progression of PD.

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CHAPTER I

INTRODUCTION

Neurological disorders are today one of the leading sources of disability in the world and those who are living with Parkinson's disease (PD) are the fastest growing population of those who live with a neurological disorder (GBD 2015, 2017). In the Parkinson's Foundation study of prevalence of PD diagnosis rates found that in 2010, 680,000 cases were in the United States of America and in 2016 over 6.1 million cases worldwide (Parkinson's Outcome Project, 2018; Marras et al., 2018). Increases in the population of those with a PD diagnosis have predicted to reach over 1,200,000 cases within the United States alone and highlight the need for increased need for healthcare infrastructure to address this increase (Achey et al., 2014; Parkinson's Outcome Project, 2018; Marras et al., 2018). Barriers for health seeking behaviors in individuals with PD include delayed diagnosis and of those diagnosed, over 40% of PD patients have been reported never consulting a neurologist, while underserved communities such as minority and rural populations are less likely to receive regular treatment (Achey et al., 2014; Ellis et al., 2013; Pan et al., 2014). The estimation of an increasing trend in those who live with PD

and the known barriers those who live with PD experience in seeking treatment highlight the need for research into community-based treatments such as the one created in the study the data reviewed for this secondary data analysis thesis.

There are also barriers for the access of community-based treatment options for those who have been diagnosed with PD. Individuals with PD find difficulty in attending community support groups and treatment due group inconsistency, fears of participation, low expectations of benefits, denial for the need of ongoing treatment, and lack of options in close proximity (Bush, Singh, Hidecker & Carrico, 2018). Exercise has been observed to increase the brain's resistance to aging and neurodegeneration due to stimulating physiological mechanisms and has been found to be both a potential preventative and therapeutic treatment option for those with PD (Farely et al., 2008). There are several options for exercise-based groups for individuals with PD, but limited in options that are provided and guided by medical professionals trained to address the needs and mitigate the risks of exercise with participants that have PD (Combs et al., 2013; Poliakoff et al., 2013). Exercise programs tailored for PD participants have included such options as boxing training, dance, yoga, water aerobics, and tai chi, which leaders and developers may or may not have sufficient training (Combs et al., 2013; Poliakoff et al., 2013). Recreational therapists are trained to create, implement, and assess an exercise program focused on the rehabilitation and maintenance of physical functioning in those with PD (Passmore, DeVries, Kavanaugh, & Fedesco, 2009; Porter, 2015).

Research Question

The purpose of this thesis is to investigate what impact a recreational therapist led, community-based balance training exercise program has on fall risk and disease severity

in individuals with PD. The following research questions have been developed regarding this secondary data analysis of participants engaging in the 16-week dual treatment featuring Recreational Therapy guided balance exercise and Speech Pathologist led LOUD Crowd® treatment session. It is theorized that participants will report equal to or lower scores on the Hoehn and Yahr Scale of PD Severity. Additionally, it is theorized that participants will improve their performance on the Biodex Balance System's Fall Risk test.

R1: What impact on Fall Risk does a 16-week dual treatment featuring Recreational Therapy guided balance exercise and Speech Pathologist led LOUD Crowd® treatment session have on an individual with PD.

R2: What impact on disease severity based on the Hoehn and Yahr Scale of PD Severity does a 16-week dual treatment featuring Recreational Therapy guided balance exercise and Speech Pathologist led LOUD Crowd® treatment session have on an individual with PD.

Hypothesis

The following hypotheses have been theorized regarding this secondary data analysis of participants engaging in the 16-week dual treatment featuring Recreational Therapy guided balance exercise and Speech Pathologist led LOUD Crowd® treatment session

$H1_0$: There will be no significant change in performance on the Biodex Balance System's Fall Risk after participation in a 16-week dual treatment session.

$H1_a$: There will be significant change in performance on the Biodex Balance System's Fall Risk after participation in a 16-week dual treatment session.

$H2_0$: There will be no significant change in disease severity based on the Hoehn and Yahr Scale of PD Severity after participation in a 16-week dual treatment session.

$H2_a$: There will be significant change in disease severity based on the Hoehn and Yahr Scale of PD Severity after participation in a 16-week dual treatment session.

Limitations

Limitations of this secondary data analysis thesis include this author not having direct control over participant recruitment, test selection, testing protocols, program creation, and program deliverance. As a secondary data analysis this author must infer that protocols were followed as reported by the original researchers and that the program was completed and adhered to as reported with limited to no data on attendance consistency of participants, medical information, individual symptomology, individual perception of difficulty of programming, or other descriptive information that could affect data outcomes.

CHAPTER II

REVIEW OF LITERATURE

PD is a degenerative neurological disorder that is manifested through the loss of dopamine secreting neurotransmitters, or dopaminergic neurons, located in the substantia nigra pars compacta of the basal ganglia, located in the midbrain (Karlsen et al., 2000; Parkinson's Outcome Project, 2018; Porter, 2015; Tysnes & Storstein, 2017). The loss of dopaminergic neurons in the basal ganglia is the main causation of PD and the development of the key symptomology, though the exact reason for the initiation of dopaminergic neuron loss is unknown, research has shown that it could be influenced by environmental and genetic factors (Karlsen et al., 2000; Parkinson's Outcome Project, 2018; Porter, 2015; Tysnes & Storstein, 2017). The prevalence of PD has become a national and global issue with reported diagnoses of 6.1 million cases worldwide in 2016, and it is estimated that almost one million Americans will be living with PD this year, which is more than the combined numbers for other neurological disorders or diseases such as multiple sclerosis, muscular dystrophy and ALS (Lou Gehrig's disease) (Marras et al., 2018; Parkinson's Outcome Project, 2018).

Men are more likely to be living with PD than women, though that is mainly due to the fact that men on average present with the symptoms that lead to diagnosis at an earlier age than the average woman and the gender prevalence differences decrease as age increases. Causes for regional differences in prevalence of PD diagnoses are still unknown, but studies have hypothesized through findings that regions with heavier industrial agriculture activity tend to have greater prevalence of PD diagnoses among individuals living in those areas than those living in areas with more traditional agriculture operations without the exposure to pesticides and other agricultural chemicals (Breckenridge et al., 2016; Elbaz & Tranchant, 2007; Mark et al., 2012; Wan & Lin, 2015; Walker et al., 2010). Studies have also shown that urban causes of pollution such as traffic could also be contributing environmental cause for PD as well as aggravate PD symptoms of those already diagnosed, even with minimal, short-term exposure (Lee et al., 2017; Ritz et al., 2016).

Symptoms and Secondary Problems

Individuals with PD experience symptoms that affect motor and cognitive functioning and these main symptoms lead to problematic secondary issues that further effect functioning and overall wellbeing (de Lau & Breteler, 2006; Karlsen et al., 2000; Parkinson's Outcome Project, 2018; Porter, 2015). Main symptoms of PD experienced are an asymmetric resting tremor, rigidity in muscles, abnormal slowness of movement, or bradykinesia, and postural instability with loss of balance (de Lau & Breteler, 2006; Karlsen et al., 2000; Parkinson's Outcome Project, 2018; Porter, 2015). Mixed motor and nonmotor symptoms include speech and swallowing complications such as sialorrhea, and nonmotor symptoms include neurocognitive disorders, orthostatic

hypotension, constipation and bladder problems, hyperhidrosis, seborrhea dermatitis, anosmia, sleep disorders, and sensory problems. (Karlsen et al., 2000; Parkinson's Outcome Project, 2018; Porter, 2015; Tysnes & Storstein, 2017) These symptoms lead to secondary problems such as falling, decreased activity, and decreases in quality of life (Archer et al., 2011; Karlsen et al., 2000; Plotnick et al., 2011). The following table, Table 1, organizes the primary and secondary symptoms into motor, non-motor, and mixed categories for concise reading and referencing.

Table 1

Summary of PD Symptoms

Primary Symptoms		
Motor	Non-Motor	Mixed
Asymmetric Resting Tremor	Orthostatic Hypotension	Sialorrhea
Muscle Rigidity	Bladder/Bowl Problems	Speech Problems
Bradykinesia	Hyperhidrosis	Swallowing Difficulty
Postural Instability	Seborrhea Dermatitis	
	Anosmia	
	Sensory and Mood Problems	
	Sleep Disorders	

Secondary Symptoms		
Falling	Decreased Activity	Decreased Quality of Life

Note. Created from de Lau & Breteler, 2006; Karlsen et al., 2000; Parkinson's Outcome Project, 2018; Porter, 2015

Falls are the main secondary problem as falls usually lead to decreased activity and quality of life due to the traumatizing experience of the fall, both physically and mentally (Plotnick et al., 2011). Individuals with PD are twice as likely to experience a fall than other neurological conditions and report a 60-70 percent higher incidence of falling than the average geriatric population (Plotnick et al., 2011). Individuals with PD experience

motor symptoms such as start-hesitation, shorten gait, and postural instability all of which contribute to a higher risk of falling in this population and this population reports a 60-70% higher rates of falling than those of the same age without a diagnosis of PD (Plotnick et al., 2011). Research has shown that individuals with PD may also experience a decrease in general activity due to the disease and falling (Archer et al., 2011; Karlsen et al., 2000; Plotnick et al., 2011). This decreased activity can cause further progressions in the neurodegeneration as well as cardiac and muscular deconditioning, which can lead to higher risk of falling and further decreases in activity which then lead to a decrease in their quality of life (Archer et al., 2011; Karlsen et al., 2000). Decreases in quality of life in individuals with PD have shown to decrease physical mobility and emotional reactions while increasing pain levels and tendency to socially isolate themselves (Karlsen et al., 2000).

Individuals in early stages of PD have been found to experience deficits in their balance and walking that have been associated with decreased levels of participation in everyday activities as well as a reduced quality of life (Carpinella et al., 2007; Conradsson et al., 2012). As PD progresses, issues with balance gradually increase and clinical trials have shown that the degeneration of balance performance are generally non-responsive to dopamine replacement therapies, which try to mitigate PD symptoms with dopamine treatment to supplement lower levels of dopamine production and some trials have even shown that these treatments can further decrease an individual's balance performance (Conradsson et al., 2012; Franzen et al., 2009; Wright et al., 2010). This lack of response to dopamine replacement therapies highlight a need for other treatments that produce dopamine such as an exercise program (Petzinger et al., 2015; Riebe, 2018). Research has

shown exercise to stimulate many neurotransmitters, including dopamine and neural connectivity within the basal ganglia (Petzinger et al., 2015; Riebe, 2018).

Postural Stability

Postural stability can be defined as one's ability to maintain and control the body's center of gravity and exists on a continuum from static balance to dynamic balance, where static balance is where no movement occurs (Pickerill & Harter, 2011). Progression of PD leads to balance impairments, which is the lack of postural stability and is present even in the early stages of the disease (Conradsson et al., 2012; Tysnes & Storstein, 2017). This secondary symptom directly leads to individual's with PD having an increased risk of falling, mainly due to the delayed or absent reactive responses, rapid reactionary reflexes that are naturally deployed when one loses balance, stumble, or slip (Conradsson et al., 2012; Tysnes & Storstein, 2017). Start-hesitation, shortened gait, and postural instability are all symptoms of postural instability that individuals with PD experience and that directly impact their fall risk and quality of life (Karlsen et al., 2000; Plotnick et al., 2011). Falls can become a dangerous cycle of increasing disability and inactivity for individuals with PD as 50 percent of those individuals report at least falling twice each year (Allen, Schwarzel, & Canning, 2013). These falls can lead to injuries, fears and anxiety about the possibility of future falls, reduced activity levels, and increased levels of reported stress for those individuals as well as caregivers (Allen, Schwarzel, & Canning, 2013).

Theoretical Foundation

Two theories provided the foundation for this thesis, the Social Learning Theory developed by the psychologist researcher Albert Bandura, and the Theoretical Balance Framework for Individuals with PD, developed by Dr. Fay Horak, a neurology researcher who specializes in balance and gait in the geriatric population, especially those with PD. Bandura's Social Learning Theory influenced the development of a group treatment setting rather than individual treatments. Horak's Theoretical Balance Framework for Individuals with PD influenced the development of balance exercise treatment and selecting activity-based interventions.

Research has shown that social support can help influence physical activity and feelings of depression, especially for those who have been diagnosed with PD (Ravenek & Schneider, 2009). This research continues to build upon Bandura's Social Learning Theory that theorizes that individuals will learn by engaging in activities with others, or by watching others who participate. (Bandura, 1971). This learning through direct experience help those individuals to continue participation within that support system as well as carry on that which was learned into their daily life (Bandura, 1971). The study used for this secondary data analysis was guided by an instructor who led the program directly through their participation, meaning the leader would demonstrate the exercise to the group and provide verbal and visual cues. This goes directly into Bandura's Social Learning Theory in the form of learning through modeling, as the participants learn how to perform the exercises or activity-based interventions through observing the leader modeling those interventions. The learning through modeling aspect of Social Learning Theory theorizes that individuals will learn either deliberately or unconsciously through

the influence of modeled examples (Bandura, 1971). Learning through modeling not only occurs between the leader and participant, but also between the participants themselves, as they can learn from each other's personal experiences of a PD diagnosis (Bandura, 1971). The study used for this secondary study also included a component of Social Learning Theory known as vicarious conditioning. Vicarious conditioning understands that individuals who have an emotional reaction to the participation within a group also affects learning, in that when someone is having a positive emotional response to performing an intervention, those who are also in the setting will be influenced by their elevated mood (Bandura, 1971). Positive emotional responses paired with an treatment experience can lead to better treatment adherence and a more positive outlook on treatment goals and diagnosis prognosis (Bandura, 1971; Ravenek & Schneider, 2009).

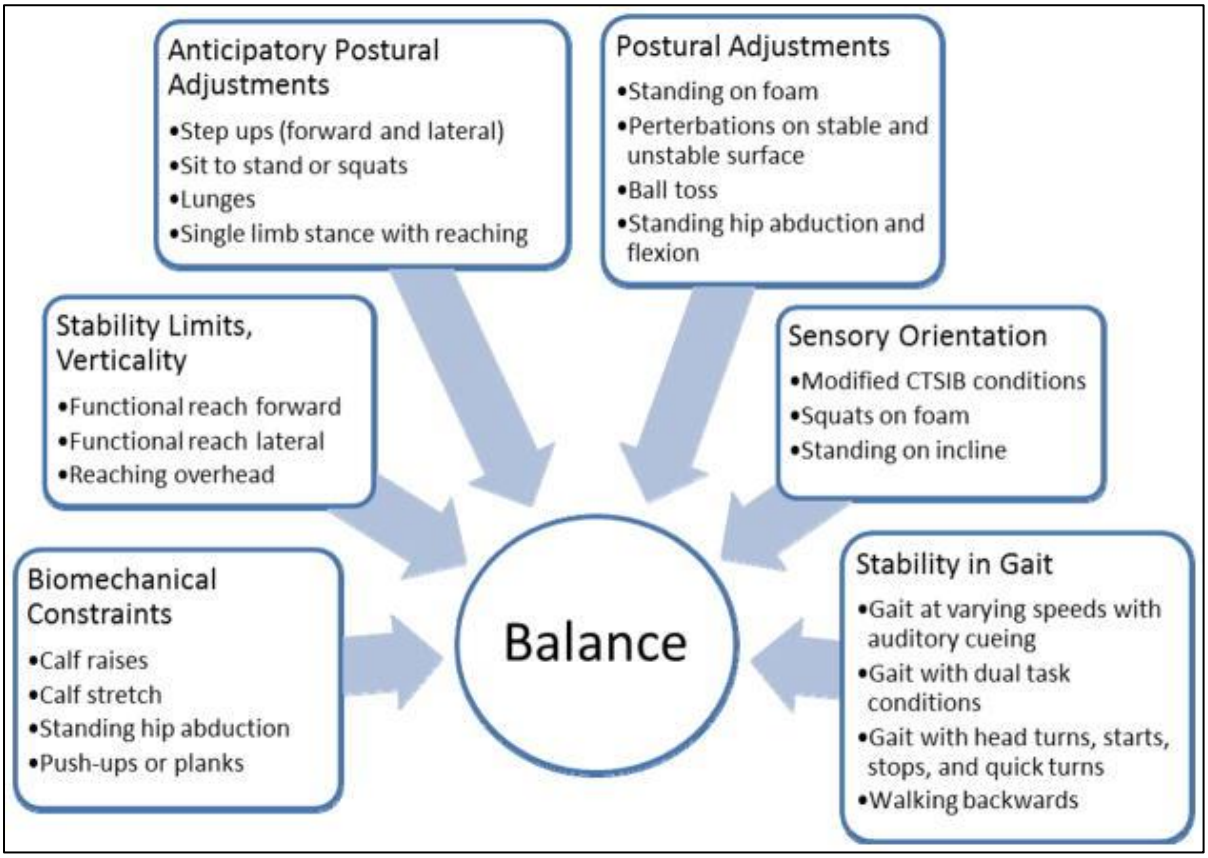
Exercises throughout a balance training program should utilize Horak's theoretical balance framework for individuals with PD, this framework focuses on six interacting systems that contribute to balance control and thus must be challenged in order to help maintain and improve balance (Horak, Wrisley, & Frank, 2009; Schoneburg, Mancini, Horak, & Nutt, 2013; Sparrow et al., 2017). These systems include Anticipatory Postural Adjustments, Stability Limits, Biomechanical Constraints, Postural Adjustments, Sensory Orientation, and Stability in Gait and include exercise activities such as sit to stand or squats, functional reaches, calf raises, ball toss, gait training with cues, and performing dual task activities (Horak, Wrisley, & Frank, 2009; Sparrow et al., 2017).

Anticipatory Postural Adjustments are otherwise known as transitioning and includes tasks that require the movement of the body's center of mass as part of a planned movement such as standing from a seated position or from a one legged stance to a two

legged stance (Horak, Wrisley, & Frank, 2009). Stability Limits refers to the limit of a person's ability to lean over their base of support, or to lean forward and reach at maximal potential laterally while standing (Horak, Wrisley, & Frank, 2009). Biomechanical Constraints for balance include the quality of the base support, or the quality of feet of the individual, postural alignment, ankle and hip strength, and the ability/inability to rise from a seated position on the floor (Horak, Wrisley, & Frank, 2009). Postural Adjustments are reactive movements performed to regain balance and feature a compensatory step in response to the stimulus of losing balance either due to internal or external sources (Horak, Wrisley, & Frank, 2009). The Sensory Orientation system refers to the change in posture, body sway, or stability during standing associated with the altering visual or surface sensory information such as change in floor angle and transitioning from light to darkened areas or closing their eyes (Horak, Wrisley, & Frank, 2009). Stability in Gait refers to individuals' ability to walk and how their balance is challenged while walking, especially when changing speed, direction, stepping over obstacles, rotating the head, and performing regular daily activities (Horak, Wrisley, & Frank, 2009). The following infographic, Figure 1, expands on the Horak's theoretical balance systems and the interventions that target those specific systems.

Figure 1.

Balance Systems and Interventions to Improve those Systems



Note. This figure was taken from Sparrow, D., DeAngelis, T.R., Hendron, K., Thomas, C.A., Saint-Hilaire, M., & Ellis, T. (2017). Highly challenging balance program reduces fall rate in Parkinson's disease. *Journal of Neurology and Physical Therapy*, *40*(1), 24-30. doi:10.1097/NPT.0000000000000111

Theory to Practice

The integration of the two previously discussed theories into the study that was used for this secondary data analysis must be assumed as the study did not report their theoretical foundation for their methodology. This secondary data analysis assumes this integration was part of the methodology due to the environment and deliverance of the program. As

stated previously, those who have PD may be fearful of participating in a balance focused exercise group due to their increased risk of falling (de Lau & Breteler, 2006; Karlsen et al., 2000; Parkinson's Outcome Project, 2018; Porter, 2015). Bandura's Social Learning theorizes that if those who have PD observe others like them participating in a balance exercise group, and being successful in their participation, may motivate that reserved individual to engage in the activity that may cause fear or anxiety (Bandura, 1971). The Horak Balance System, as discussed, assists in the creation of balance exercise programs that are challenging, but specifically designed for those with balance impairments such as individuals with PD (Horak, Wrisley, & Frank, 2009; King & Horak, 2009). The treatment design of the study states that the program provided participants with cues for performance, reinforcement for positive behaviors, and demonstrations for correct and new behaviors which directly connect to and reinforces Bandura's Social Learning theory (Bandura, 1971; Bateman et al., 2020).

Recreational Therapy

Recreational Therapy (RT) is a systematic process that utilizes recreation and other activity-based interventions to address the assessed needs of individuals served (Passmore, DeVries, Kavanaugh, & Fedesco, 2009; Porter, 2015). Recreational therapists can use several interventions that address the symptoms of PD and directly address the secondary problems associated with PD. Recreational therapists can utilize activity based interventions which include exercise and other recreational activities to challenge the vestibular system, training the balance centers of the brain, to help promote balance and balance loss recovery (Porter, 2015). Recreational Therapists work within the settings of in-patient physical rehabilitation, senior living facilities, and community settings and thus

are positioned to provide services for individuals with Parkinson's disease. Limited research has been conducted till now on the benefits of a Recreational Therapist led group exercise intervention for this population, however multiple studies have been conducted by physicians and physical therapists into the benefits of exercise in individuals with PD. This researcher found research gaps in the benefits of a Recreational Therapist led group exercise for individuals with PD. Utilizing the EBSCO Databases inputting search phrases "recreational therapy" and "Parkinson's disease" only seven results were found, with three articles being related to exercise, studying the effects of Tai Chi and dance. This research gap highlights the importance of creating research programs like the one referenced in this secondary data analysis.

Benefits of Exercise Programs

Exercise, as defined by the American College of Sports Medicine (ACSM), is the planned, structured, and repetitive physical activity that are performed to improve or maintain one or more components of physical activity or health (Riebe, 2018; van der Kolk & King, 2013) Several studies have highlighted the benefits of regular exercise for individuals with PD, which include promoting neuroplasticity, improvements in functional mobility, promotes dopaminergic neurotransmission, improvements in balance, strength, and walking performance, and improving scores in the Unified Parkinson's disease rating scale (Conradsson et al., 2012; Mak et al., 2017; Petzinger et al., 2010; Petzinger et al., 2015; Riebe, 2018). A successful exercise program has been theorized to be comprised of specificity, progressive overloading, and programming that is varied, complex, and challenging for the individual (Conradsson et al., 2012; Riebe, 2018). Specificity of exercise focuses the exercise tasks per the functional needs of

participants and is specific for that population. Thus, for those with PD, balance and fall risk prevention should be the main focus of exercise training and programs should provide specific balance training goals that target the impairments in balance control associated with the secondary symptoms of PD (Conradsson et al., 2012). Progressive overloading is the concept of progressively increasing the challenge or intensity of an exercise program, doing so can help in creating a stimulating program that has been found to increase program adherence with the program (Conradsson et al., 2012). Creating an exercise program that features variety in balance training modalities also adds to the challenge and helps participants gain confidence in performing physical activity such as participating in recreation (Conradsson et al., 2012; van der Kolk & King, 2013).

Community-Based Exercise

Research into community-based exercise groups have been found to be beneficial for those of the average geriatric population, and beneficial for special populations that live with chronic conditions or illnesses such as PD (Powell-Cope et al., 2014; Riebe, 2018). Studies have also found that community-based exercise groups provide multiple benefits for multiple diagnoses and chronic conditions such as cardiovascular accidents, strokes, dementia, peripheral neuropathy, and cancer as well as individuals with PD (Powell-Cope et al., 2014). A guided exercise group within the community has been theorized to build upon support systems, research has found greater participation adherence of the participants than individual, non-led exercise (Powell-Cope et al., 2014; Riebe, 2018). Research has found that a group exercise program designed for older adults help increase performance of activities of daily living, feelings of independence, and improvements in

overall physical strength and functioning as well as balance (Levy, Thralls, Goble, & Krippes, 2018). Community settings would be appropriate for treatment of individuals with PD as research has shown that a community group exercise program focusing on activities that target and challenge an individual's balance, strength, gait, and dual task performance is an effective method of delivering therapeutic benefits for individuals with PD (Duchesne et al., 2015; Fernandes et al., 2015; Gobbi et al., 2009; King & Horak, 2009; Schenkman et al., 2012; Riebe, 2018; van der Kolk & King, 2013).

Flexibility

Flexibility is defined by the ACSM as the ability to move any given joint through its complete Range of Motion (ROM) (Riebe, 2018). Programs that feature flexibility are designed to focus on and improve coordination and the concept of muscle length rather than repetition and resistance (Emilio, et al., 2014; Reuter et al., 2011; Riebe, 2018; Schenkman et al., 2015). Stretching is the act of moving a limb or body part in a controlled and directed way through its ROM (Riebe, 2018). ACSM guidelines for training individuals with PD include flexibility exercises such as static stretching, which involve holds, and dynamic stretching, which involve gentle movements. ACSM guidelines suggest that these stretches be performed two to three times each week to maintain an individual with PD's flexibility. Static stretching involves moving muscle groups or limb to ROM limits and holding the position for ten to thirty seconds (Riebe, 2018). Dynamic stretching involves moving multiple muscle groups to ROM limits without holding, but in a constant, slow, and low intensity movements (Riebe, 2018). Stretches for individuals with PD should be focused on muscle groups that are affected by the cardinal symptoms and secondary problems from the progression of the disease.

The muscle groups that need to be included in every exercise and balance program include the thoracic and lumbar, shoulder, hip, and ankle muscle groups (Emilio, et al., 2014; Reuter et al., 2011; Riebe, 2018; Schenkman et al., 2015).

Physical Fitness

Physical fitness is defined by the ACSM as one's ability to carry out daily tasks of life without fatigue and without interfering with recreational activity and other leisure and personal pursuits or possible unforeseen emergencies (Riebe, 2018). Physical strength and endurance are key parts of physical fitness and are important aspects of performing daily tasks such as transferring from a seated to a standing position, walking long distances, and performing leisure activities (Emilio, et al., 2014; Gobbi et al., 2009; Porter, 2014). ACSM guidelines for training individuals with PD include strength and endurance exercises that focus on prolonged and rhythmic activities that use large muscle groups or the entire body at a moderate intensity for at least 30 minutes three days a week (Riebe, 2018). Strength and endurance exercises for individuals with PD should be focused on muscle groups that are affected by the cardinal symptoms and secondary problems from the progression of the disease. The muscle groups that need to be strengthen in every exercise and balance program include the hip and lower body, upper back, neck, shoulder, and upper and lower extremity muscle groups (Canning et al., 2009; Gobbi et al., 2009; Prodoehl et al., 2014; Riebe, 2018).

Balance

Balance training is a part of functional training, called neuromotor exercise, which is defined as exercise training that involves the combination of motor skills, proprioception,

and other neurocognitive abilities to challenge the vestibular system to improve balance and postural stability (Riebe, 2018). Research has found that participants who are elderly and participate in regular balance training at least 3 days a week, adding up to 30 minutes per week, have shown improvements in balance, agility, and muscle strength while reducing the risk of fall and the fear of falling and improve postural stability and balance performance in individuals with light to moderate PD (Dibble & Lange, 2006; Dibble et al., 2008; Dibble, Addison, & Papa, 2009; Garber et al., 2011; Riebe, 2018). A combination of static, dynamic, and balance training during functional activities is recommended for individuals with PD (Riebe, 2018). Most individuals with PD fall while performing multiple tasks, or long and complex movements, so practicing such movements in a controlled, and safe environment is beneficial (Morris, 2006; Morris, Martin, & Schenkman, 2010; Riebe, 2018).

Dual Task Treatment

Motor-Cognitive training, or dual task treatment, is the combination of physical and cognitive activity that requires the participant to engage in controlled movements while performing cognitive tasks (Fritz, Cheek, & Nechols-Larsen, 2015; Kelly, Eusterbrock & Shumway-Cook, 2012). Exercises and activities that engage motor-cognitive abilities like these can greatly enhance the benefits of Parkinson's disease treatment sessions due to their direct focus on the degenerative symptoms and progression of the disease (Fritz, Cheek, & Nechols-Larsen, 2015; Kelly, Eusterbrock & Shumway-Cook, 2012). Dual task treatments include such activities as walking with cues to walk in time with music, repeating phrases spoken to them or counting by random intervals, and catching balls and calling out the ball's color or a word or object that starts with the same letter as the color.

Using such modalities within an exercise program, research has shown that participants may show increases in gait velocity, stride length, balance, and cognitive ability while also becoming more proficient in performing dual task activities themselves (Fritz, Cheek, & Nechols-Larsen, 2015; Kelly, Eusterbrock & Shumway-Cook, 2012).

BioDex Balance System Measurement

The BioDex Balance System's (BBS) Fall Risk (FR) test assists in the identification of those with a greater risk of falling than the average person of their age group, and especially in the geriatric population (Finn et al., 1999). Participants are scored on a stability index range of 0-5 that is compared to age dependent normative data where if the individual scores higher than their age group, it is suggested that they be further assessed for balance deficiencies due to lower extremity strength, proprioception and vestibular deficiencies and recommended for balance training interventions (Finn et al., 1999). The BBS is a balance measurement device that was designed to assess and record changes in balance and postural control with an unstable balance platform (Biodex Medical Systems). During testing, participants complete three trials of 20 seconds while the platform they stand on gradually decreases in stability level, as in the platform gets more unstable as the trial proceeds, each trail is separated by a ten second rest period. There is no current gold standard in testing dynamic postural stability and fall risk, though the reliability of the BBS FR test has been found to be acceptable (ICC = .80) with a low variation in method error and a valid measure (r = .87) (Parraca et al., 2011; Pickerill & Harter, 2011).

Hoehn and Yahr Scale of PD Severity

The Hoehn and Yahr Scale (H & Y Scale) was introduced in 1967 and has since become the most common and widely used scale to estimate the severity of PD (Hoehn & Yahr, 1967; Zhao et al., 2010). The H & Y Scale is used as a simple staging assessment to evaluate the severity and progression of the overall symptoms and dysfunction of PD based on bilateral motor movements, gait, and balance dysfunction (Hoehn & Yahr, 1967; Zhao et al., 2010). The H & Y Scale includes five stages on the scale, each based on the disability and progression of the disease and ranges from one to five (Hoehn & Yahr, 1967; Zhao et al., 2010). Stage one represents those who are at the least severe stage of PD and features unilateral symptomology, with little to no functional impairment experienced by the individual (Hoehn & Yahr, 1967). Stage two represents when an individual's symptoms progress to occur bilaterally, but with the absence in balance impairments (Hoehn & Yahr, 1967). Stage three represents the presentation of the first balance impairments such as impaired stability reflexes and unsteadiness as the individual turns or when gently pushed with their eyes closed (Hoehn & Yahr, 1967). Stage four features a significant increase in the progression of PD as the individual is still able to walk and stand without assistance, but that individual is observably impaired and stage five represents the final stage and individuals in stage five are functionally impaired to the degree of needing a wheelchair for mobility or confined to a bed (Hoehn & Yahr, 1967).

SPEAK OUT!® and LOUD Crowd® Program

The study reviewed for this secondary data analysis study was a multidisciplinary treatment that included the previously mentioned recreational therapy exercise program

as well as a Speech Pathologist led treatment program. This program is named SPEAK OUT!® and is a 12 session intensive individual therapy program that aims at increasing awareness of the patient's volume and pitch range of their voice by utilizing recording equipment like a sound level meter (Levitt, 2014). The LOUD Crowd® program is a continuation of the SPEAK OUT!® treatment program, where patients continue their participation in speech pathologist led treatments in a group setting that continues to focus on voice production and utilizing recording equipment for feedback in more conversational settings. These treatments include a warmup phase of high to low ranges of voice production, clear and continuous counting, reading aloud sentences and conversational phrases, extended out loud readings of participant's choice, and then a cognitive speech modality such as a puzzle or word association (Bateman et al., 2020). Research has found that participants with PD who participated the LOUD Crowd® program may improve their voice functioning and have better voice quality than individuals with PD who do not participate in weekly sessions (Levitt, 2014; Levitt, Chitnis, & Walker-Batson, 2015).

Secondary Data Analysis Study

The following study is a secondary data analysis using data collected, but not analyzed, from a previously completed study into the effects of an exercise group developed for individuals with PD focusing on overall balance and functional ability (Koziol & Arthur, nd). This author was able to access this data due to direct observation of the original research by Bateman, Parveen, Brickell, Romoser, and Passmore. The hypotheses and data sets featured in this thesis were not analyzed by the original research and this thesis seeks to gain greater understanding of the effects of a balance focused exercise program

on fall risk and PD severity. The following study was completed under the approved IRB: Protocol #: AS-19-61.

CHAPTER III

METHODOLOGY

The study chosen for this secondary data analysis was conducted by researchers from Oklahoma State University and participants were selected from a convenient sampling of individuals willing to participate from those who attended a local Stillwater, OK PD support group. Participants in the research study cited in this secondary data analysis study included six individuals with PD aged 66-82 who rated relatively severe (1-3) on the H & Y Scale of PD severity. Two of the participants had bilateral deep brain stimulation surgery 1-2 years before their participation in the study. The physical symptoms of the participants included changes in gait, rest tremors, peripheral neuropathy, and balance deficits. All participants had completed prior speech and cognitive therapy before enrollment in the current study. All participants participated in the RT and LOUD Crowd® programs. The disease severity of all participants was assessed during pre-testing data collection using the H & Y scale.

The following information in Table 2 includes the participant demographic information that was collected.

Table 2.

Demographic Information of Participants

Participants	Age, Gender	Disease Duration (in years)	Baseline PD Severity (H & Y Scale)
PD 01	73, Male	9	3
PD 02	73, Female	1	1
PD 03	70, Male	7	2
PD 04	82, Female	12	2.5
PD 05	75, Male	4	3
PD 06	66, Male	4	1.5

Note. PD 05 and PD 06 had bilateral DBS.

Note. Table taken from Bateman, Parveen, Brickell, Romoser, & Passmore (2020). Effects of recreational therapy and speech therapy among participants with Parkinson disease and Parkinson plus conditions: Findings from a 16-week multidisciplinary program. Unpublished.

Program Design

All participants attended weekly 40-minute session of RT guided exercise, followed by the Speech Pathologist led LOUD Crowd® sessions for another 45 minutes for a total of 16 weeks. Data was collected pre and post the 16-week intervention, for this secondary data analysis study, this thesis will focus on the data collection of the Biodex Balance

System for the Fall Risk Index. The LOUD Crowd® activities included a vocal warm-up, sustained phonation, reading, and cognitive activities aimed to improve the loudness and overall communication effectiveness. The RT facilitated balance and postural control exercise group included a five-minute whole-body warm-up, 10-minute balance exercises, 10-minute muscular endurance and functional movement exercises, 10-minute dual-task exercises, and ended the session with a five-minute cool-down. Modifications were made when appropriate for either participant safety or to allow individuals to continue participation and all participants were encouraged to work at a self-controlled pace and instructed to rest and drink water as necessary. For safety purposes, the recreational therapists provided spotting as needed during the balance exercises. Participant spouses could join in on the participation of the RT exercise program but did not participate in any data collection testing. Participants were gathered via convenience sampling as participants were recruited from a local PD support group and those who participated in the study and tested were those who volunteered as well as completed the study. Participants engaged in this study voluntarily as no compensation was given for their participation in the study.

Testing Protocol and Data Collection

Testing protocol for the H&Y Scale was reported as being conducted by the Speech Pathologist, who was trained by and shadowed a movement specialist trained in teaching the H&Y Scale protocol. Tester was reported to not change between baseline and post data and participants were interviewed and observed to collect data for the H&Y Scale. The interview is not scripted, but organized to seek answers to participant's daily activities, difficulties in physical functioning, and the effectiveness of their medication

(Bateman et al., 2020). Observation of the participants' overall functioning includes rigidity checks in the upper and lower extremities, neck, and bilateral checks as well as a retropulsion test. The retropulsion test is a test to observe balance recovery and reaction time (Bateman et al., 2020). The tester stands behind the participant and the test pulls back on the participant with just enough force to break their balance (Bateman et al., 2020). If the participant recovers their balance within 3 recovery steps, then they receive a pass and is completed twice by the participant once as a trial then as the test (Bateman et al., 2020).

Testing protocol for the BBS Fall Risk test was reported as being conducted by the Recreational Therapy graduate research assistant, who was trained by a licensed certified Exercise Physiologist in how to deliver the testing protocol using the Biodex Balance System SD instrument and computer. Tester was reported to not change between baseline and post data and tester followed the testing protocol of three trials of 20 seconds while the platform gradually decreased in stability level, each trail is separated by a ten second rest period for each participant (Bateman et al., 2020). Tester was assisted by one or two additional assistants as needed for the safety of the participant. Testing of Fall Risk was completed in between measurements on the Biodex Balance System SD instrument not included in this secondary data analysis, and participants were given the option to rest in between measurements (Bateman et al., 2020).

Data was compiled and organized for statistical analysis using computer programs Microsoft® Excel® and IBM SPSS® Version 24.0.0.0. Statistical analysis will be conducted with nonparametric statistics because the study used for this secondary data analysis did not meet the criteria for parametric statistical testing due to the low number

of participants. Pre and post data from the 16-week program will be analyzed by nonparametric Wilcoxon rank-sum test to analyze trends and significance of change for the H & Y Scale and the Biodex Balance System's Fall Risk assessments. Correlations statistics will be analyzed by Spearman Rho test for correlational trends and significance between the H & Y Scale and the Biodex Balance System's Fall Risk at both pre and post data collection points.

CHAPTER IV

FINDINGS

Data collected from pre and post testing was statistically analyzed and organized into a table (see Table 3).

Table 3.

Individual Participant Pre/Post Testing Results

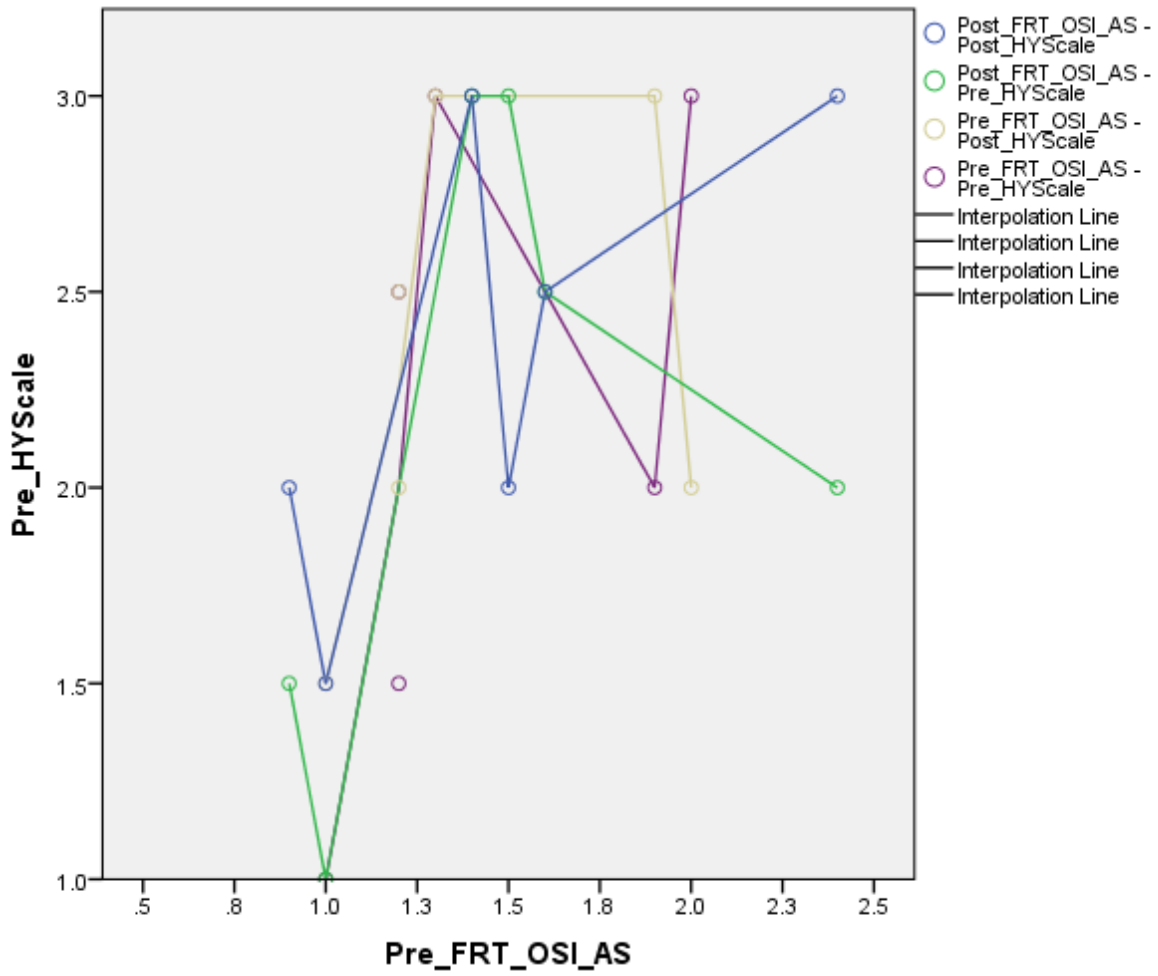
Participants	Age, Gender	Baseline PD Severity (H & Y Scale)	16-Week PD Severity (H & Y Scale)	Baseline Biodex: Fall Risk	16-Week Biodex: Fall Risk
PD 01	73, Male	3	3	1.3	1.4
PD 02	73, Female	1	1.5	1	1
PD 03	70, Male	2	3	1.9	2.4
PD 04	82, Female	2.5	2.5	1.2	1.6
PD 05	75, Male	3	2	2	1.5
PD 06	66, Male	1.5	2	1.2	0.9

Note. PD 05 showed improvement in both H&Y Scale and Biodex Fall Risk Scores.

Spearman's rho correlation statistic test results for the Fall Risk pretest and posttest comparison found no statistical significance, .551(p=.257) and Wilcoxon Signed Ranks Test also found no statistical significance, z=-.271(p=.786). For the H&Y Scale, the Spearman's rho correlation statistical analysis of pretest and posttest comparison found no statistical significance, .537(p=.272) and the Wilcoxon Signed Ranks Test also found no statistical significance, z=-.557(p=.577). Pre and Post differences were also calculated for participant averages for each test. Fall Risk Pre and Post difference was (-0.0333) and the H&Y Scale Pre and Post difference was (-.16667) showing both averages to have increased over the 16-week program. The following figures (Figures 2, 3, 4, and 5) highlights the correlational trends of the testing pairs that will be discussed in the next chapter.

Figure 2.

Pre/Post H&Y Scale and Pre/Post Biodex Fall Risk



Note. This figure is the combination of all data points with the two tests being the x axis and y axis and highlights the relationship between the H&Y Scale for PD Severity and the BBS Fall Risk test.

[a]Pre_HYScale – Baseline Data H&Y PD Severity Scale

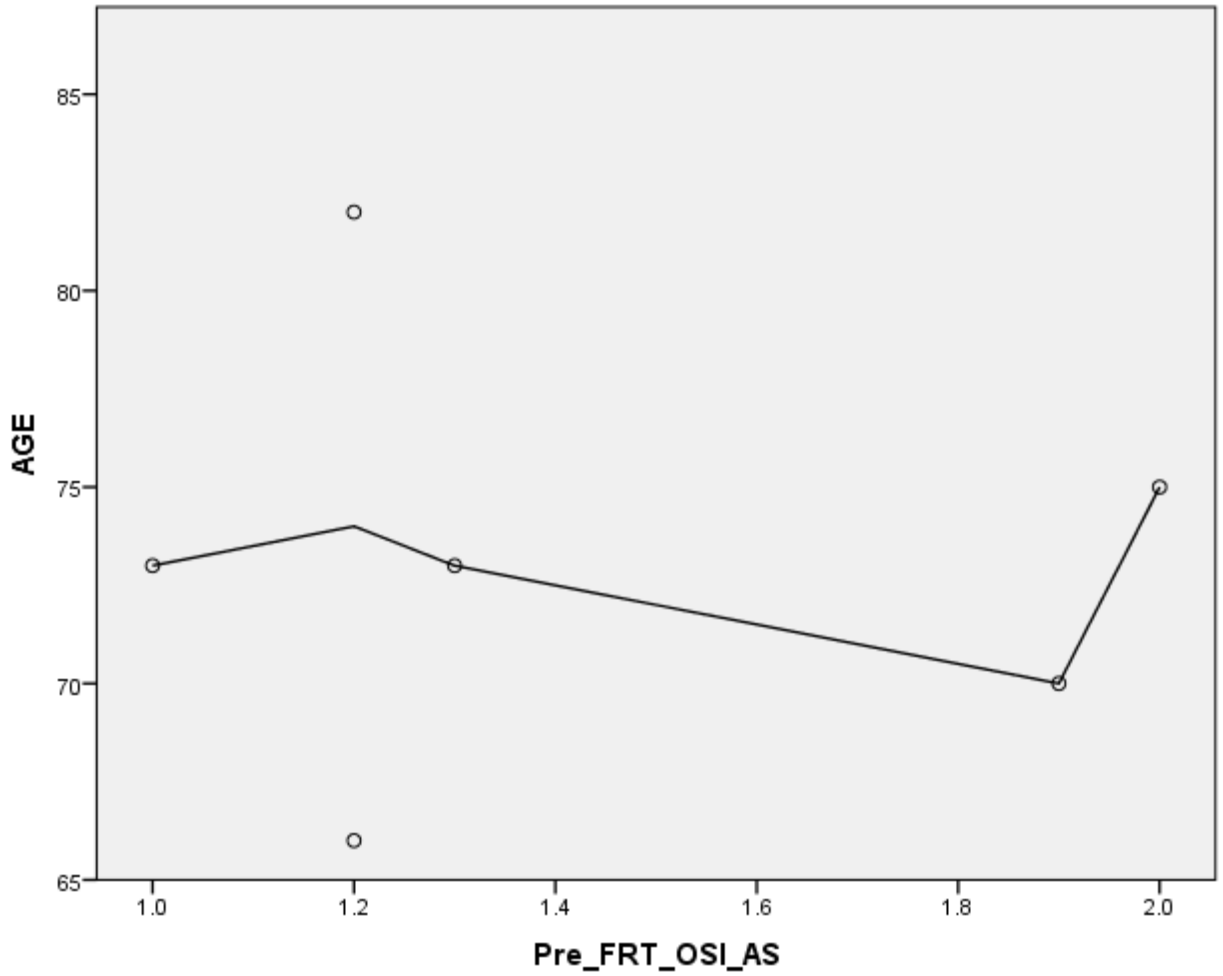
[b]Pre_ FRT_OS_AS – Baseline Data BBS Fall Risk Test

[c]Post_HYScale – Post Data H&Y PD Severity Scale

[d]Post_FRT_OS_AS – Post Data BBS Fall Risk Test

Figure 3.

Age and Fall Risk Performance



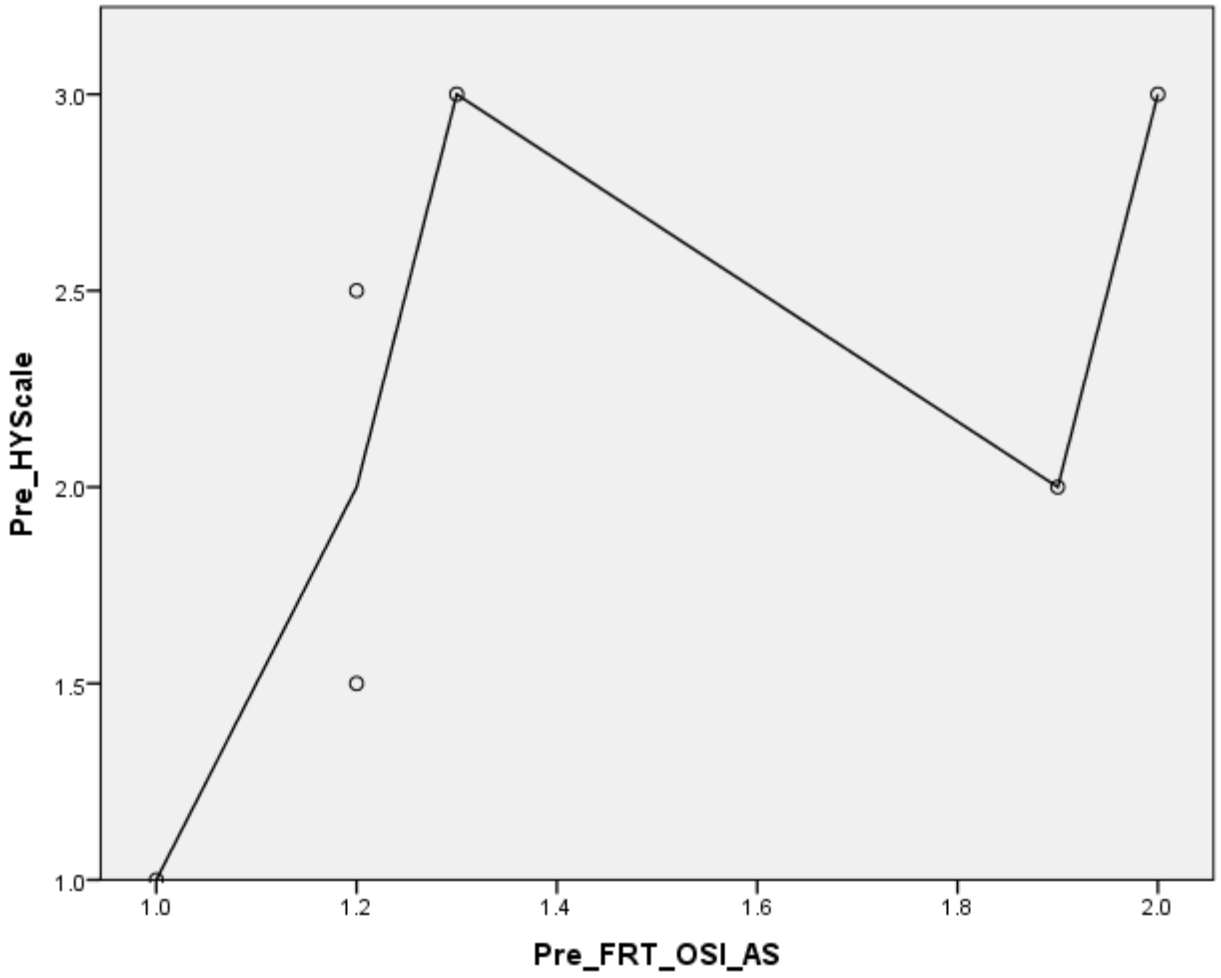
Note. This figure is the organization of data to observe the relationship between baseline data of the BBS Fall Risk test and Participant Age.

[a]AGE – Age of Participant

[b]Pre_ FRT_OS_AS – Baseline Data BBS Fall Risk Test

Figure 4.

H&Y PD Severity Scale and Fall Risk



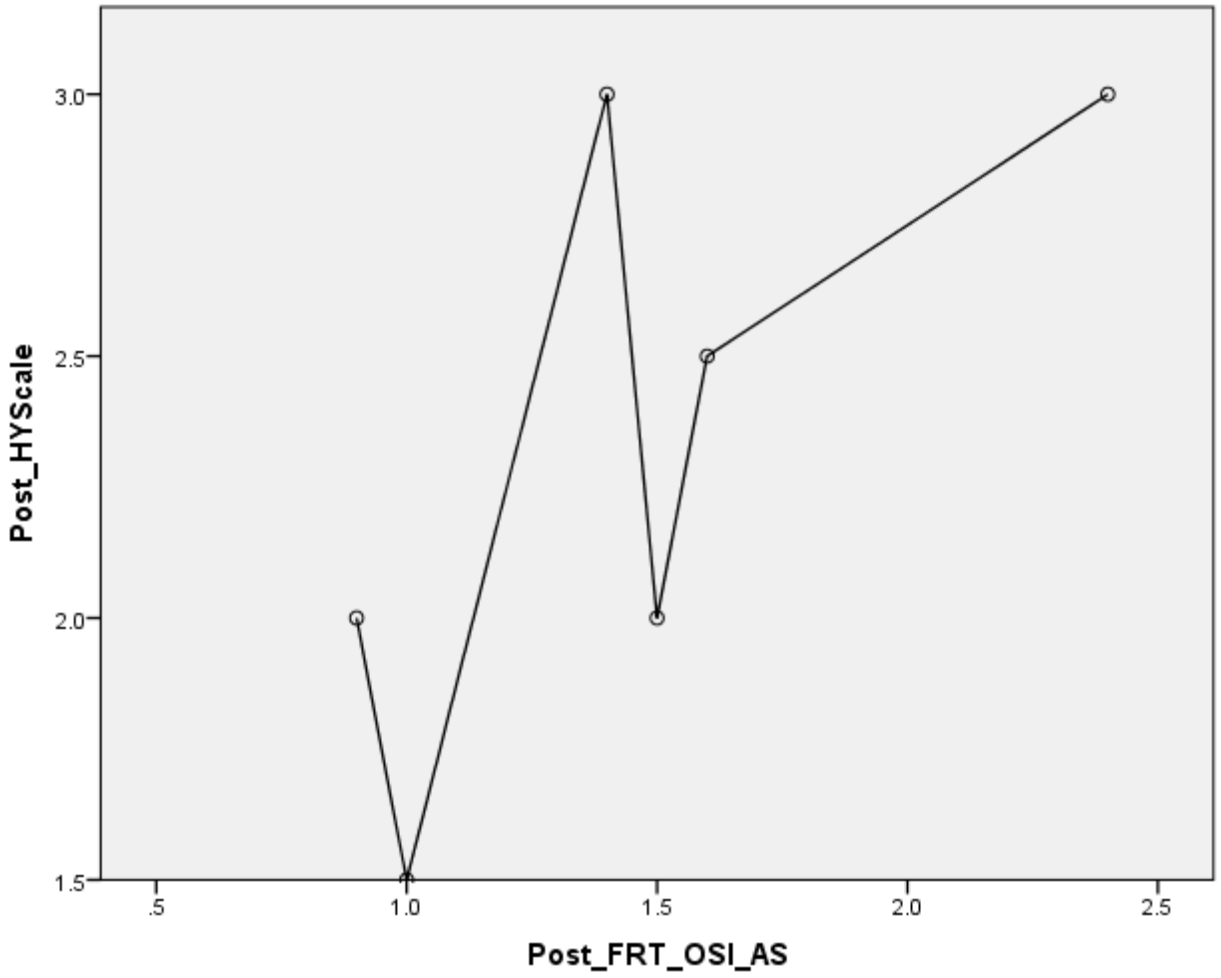
Note. This figure is the organization of data to observe the relationship between baseline data of H&Y Scale for PD Severity and the BBS Fall Risk test.

[a]Pre_HYScale – Baseline Data H&Y PD Severity Scale

[b]Pre_ FRT_OS_AS – Baseline Data BBS Fall Risk Test

Figure 5.

Fall Risk Pretest and Fall Risk Posttest



Note. This figure is the organization of data to observe the relationship between post program data of H&Y Scale for PD Severity and the BBS Fall Risk test.

[a]Post_HYScale – Baseline Data H&Y PD Severity Scale

[b]Post_ FRT_OS_AS – Baseline Data BBS Fall Risk Test

CHAPTER V

CONCLUSION

While no significance was found in either correlation, nor comparison statistical analysis of pre and post testing, some trends have been found and observations made that warrant discussion. Positive trends were observed in both testing parameters as most of the participants either increased or maintained their performances in the Fall Risk test and how they were scored on the H&Y Scale of PD Severity. One participant (PD 05) improved their performance on the Fall Risk test while also being observed to have a decrease in their PD severity, while another participant (PD 03) decreased their performance on the Fall Risk test while being observed to have an increase in their PD severity. The difference of averages of the participants' pre and post data found that on average, the participants performed slightly worse (-0.0333) on the Fall Risk test while also experiencing a slight increase (-0.16667) in their disease severity. On the H&Y Scale of PD severity, one participant was recorded as having their symptoms decrease in severity, two participants maintained their current level on the scale, while three of the

participants experienced an increase in their symptom severity. As stated in the literature review, PD is a progressive degenerative disease, and thus, the fact that half the participants either maintained, or experienced a decrease in the severity of their symptoms over a 16-week time period might lead one to consider developing future investigations into the relationship of the interventions in this study to the degenerative process of PD. Longitudinal studies with this design would be desired to observe possible continued maintenance of symptom severity and comparing data to H&Y Scale database for average duration of stage and average observations of PD progression. Research has found that on average, individuals with PD progress through the stages at a rate based on individual health and preexisting health issues, though on average, progress from one stage to the next in about two or three years (Zhao et al., 2010). This further highlights the need for this study to be continued and data collected over a longitudinal study for multiple years. This would allow further observations into the benefits of balance training and to observe any relationship the program may have with the progression of PD symptoms.

Performance on the Biodex Fall Risk test was mixed as two participants decreased their Fall Risk, one participant maintained their Fall Risk, and three participants were observed to have an increase in their Fall Risk after participating in the 16-week program. No significance was found, though upon closer look at the data, we can positive trends that could help strengthen the clinical significance of this program. One of the participants (PD 01) increased their Fall Risk, but only so by a modest amount (0.1) compared to the other two participants who recorded an increase in Fall Risk (0.4 & 0.5) and could be considered among those who did not change in their Fall Risk. Therefore, after 16 weeks

of participating in this dual treatment session, four of the six participants either improved or maintained their baseline balance capabilities. The increases observed in Fall Risk of two participants (PD 03 & PD 04) require further analysis as Participant PD 03 was also observed to have an increase in symptom severity during the 16-week program, though Participant PD 04 maintained their scale level on the H&Y Scale. A possible limitation to this study's results could be the length between testing times, and including an 8 week midline data set could have granted further incite. As stated previously in this discussion, a longitudinal study over multiple years would be beneficial to further study whether these trends, positive or negative, are due to the program being researched, or the progression of PD.

While there was no significance in the correlation between baseline BBS Fall Risk test and the H&Y Scale, it did have a strong positive trend that was close to being significant, .735 (p=.096). While examining Figure 3, the relationship between the participants' Fall Risk Performance and their disease severity on the H&Y Scale can be observed. When compared to the relationship between the participants' Age and the Fall Risk Performance in Figure 4, one can observe that the H&Y Scale may be a more accurate predictor of performance for the BBS Fall Risk test than Age. This highlights the need for practitioners to utilize acceptable and reliable assessment protocols when developing treatment programming for those with PD. The low subject sample size should be noted, and future studies could be developed to include a larger population size that could produce more clearer relationship between the H&Y Scale and BBS Fall Risk test performance. A partnership between the manufacturer of the test and PD organizations could produce a nation-wide database in which an individual with PD could compare

their Fall Risk test data to others with PD that are on the same stage of disease progression.

This secondary data analysis further expands on the researched benefits of providing individuals with PD an exercise program that targets their ability to balance and maintain functioning (Conradsson et al., 2012; Mak et al., 2017; Petzinger et al., 2010; Petzinger et al., 2015; Riebe, 2018). Specific implications for the field of Recreational Therapy from this secondary data analysis are important to discuss as well. As stated in the literature review, limited research has been conducted to this day utilizing Recreational Therapy as a mean of delivering a balance focused exercise treatment, in either group or individual settings. The results discussed above support the usage of recreational therapy to deliver this as a treatment option that could complement existing pharmacological and behavior modification treatment options for those who have been diagnosed with PD. This research should be utilized as a tool in Recreational Therapy advocacy for coverage with governmental and private insurance providers and promoted as part of their community outreach. Recreational Therapy professionals should look for studies much like this one when they are advocating for their patients during treatment meetings and in their advocacy for more prescribed hours for treatment.

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APPENDICES

Oklahoma State University Institutional Review Board

Date:	11/21/2018
Application Number:	AS-18-2
Proposal Title:	Effects of Multidisciplinary Intervention Among Individuals with Parkinson disease or secondary forms of Parkinson Disease
Principal Investigator:	SABIHA PARVEEN
Co-Investigator(s):	
Faculty Adviser:	
Project Coordinator:	
Research Assistant(s):	

Status Recommended by Reviewer(s): Approved
Approval Date: 02/08/2018
Expiration Date: 02/07/2019

The requested modification to this IRB protocol has been approved. Please note that the original expiration date of the protocol has not changed.

Modifications Approved:
Modifications Approved: Change title from "Long-Term Effects of SPEAK OUT!® and LOUD CROWD®
Among Individuals with Parkinson Disease or secondary forms of Parkinson Disease" to "Effects of
Multidisciplinary Intervention Among Individuals with Parkinson disease or secondary forms of Parkinson Disease"

Add Michelle Bateman and Tim Passmore as Co-PIs

Add PDQL, MFES, HADS measures and Biodex Balance System and TUG

A certified exercise physiologist will design the recreational therapy intervention protocol and will be present during recreational therapy intervention. The recreational therapy interventions will include a 10 to 15 minute warm-up, focusing on gross motor and fine motor motions.

The IRB office MUST be notified when a project is complete or you are no longer affiliated with Oklahoma State University.

All approved projects are subject to monitoring by the IRB.

The final versions of any recruitment, consent and assent documents bearing the IRB approval stamp are attached. These are the versions that must be used during the study.

Sincerely,

Oklahoma State University IRB

VITA

Brandt Auston Brickell

Candidate for the Degree of

Master of Science

Thesis: EFFECTS OF RECREATIONAL THERAPY BALANCE EXERCISE PROGRAM IN INDIVIDUALS WITH PARKINSON'S DISEASE AS PART OF A MULTIDISCIPLINARY TREATMENT: A SECONDARY DATA ANALYSIS STUDY ON FALL RISK AND DISEASE SEVERITY

Major Field: Leisure Studies

Biographical:

Education:

Completed the requirements for the Master of Science in Leisure Studies at Oklahoma State University, Stillwater, Oklahoma in December, 2020.

Completed the requirements for the Bachelor of Science in Kinesiology - Exercise/Fitness Management and in Kinesiology - Outdoor and Community Recreation at University of Central Oklahoma, Edmond, Oklahoma in 2015.

Experience:

American Therapeutic Recreation Association Convention Speaker, 2019/2020
Oklahoma Therapeutic Recreation Association Convention Speaker, 2018/2019/2020

Professional Memberships:

American Therapeutic Recreation Association (ATRA) – Student Development Committee Member
American Therapeutic Recreation Association (ATRA) – student member
Oklahoma Recreation Therapy Association (ORTA) – student member
Rho Phi Lambda, Oklahoma State University Alpha Kappa Chapter – inducted member