THE FEASIBILITY OF A LARGE-AMPLITUDE AQUATIC-BASED EXERCISE OCCUPATIONAL THERAPY PROGRAM FOR INDIVIDUALS WITH EARLY PARKINSON'S DISEASE

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ABSTRACT

Purpose

The purpose of this research was to determine if a 4-week aquatic-based, large-amplitude exercise program would increase strength and coordination for occupational performance in areas of activities of daily living (ADLs) and mobility in individuals with Parkinson's disease (PD) stage I-II, functional mobility as measured by Timed Up and Go test, and quality of life as measured by PDQ-39 in relation to occupational engagement.

Methodology

Recruitment was through capstone placement site, Hands on Rehab, 7921 Professional Circle, Huntington Beach, CA 92648, in which a signed EAA was on file. Informed Consent was reviewed by the student-clinician as well as the supervising clinician prior to assessments or engagement in the program. One participant met criteria and was recruited for the four-week program that ran from February 2023 - March 2023. Data was analyzed through Paired t-test of survey pre- and post-measures.

Outcome

The participant in this study was 68 years old with a Hoehn and Yahr stage of 1.5, indicating mild Parkinson's disease symptoms. The statistical analysis revealed a clinically significant improvement in TUG scores, with a notable decrease of about 32% (from 17.51 seconds to 11.92 seconds). The participant went from a fall risk to no fall risk. Similarly, the PDQ-39 showed an improvement of 34.1% with a p-value of $p = 0.058$. These findings suggest that the aquatic intervention employed in this study has the potential to positively impact balance, functional mobility, and quality of life in individuals with Parkinson's disease.

Conclusion

The project was significant for the occupational therapy (OT) profession as it revealed the beneficial and safe impact of aquatic therapy on the occupational performance of individuals with PD (stages I and Il), indicating the need for further research to improve outcomes within the scope of practice for OT practitioners. Aquatic therapy, similar to OT, follows a holistic approach to assess clients through an occupational lens and aligns with the OT profession's scope of practice. The study's primary objective was to determine the program's feasibility, which was supported through the results. Additionally, the study aimed to examine the views of a participant with PD on this large-amplitude aquatic therapy program's effects on posture, balance, and functional performance, paving the way for meaningful assessments, outcomes, and future studies.

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SECTION I

INTRODUCTION

Introduction to Occupational Therapy

Occupational Therapy Practice Framework: Domain and Process (4th ed.; AOTA, 2020) defines occupational therapy (OT) as "therapeutic use of everyday life occupations with persons, groups, or populations (clients) to support occupational performance and participation" (p. 80). OT practitioners use a holistic approach to assess, treat, and interact with clients to improve their functional performance in their everyday life.

The emerging profession of aquatic therapy, much like OT, focuses on a holistic approach when assessing a client through an occupational lens and is significant to the OT profession as it fits into the OT scope of practice. The aquatic setting provides a different environment for people to increase their occupational performance.

This doctoral capstone was intended to develop, implement, and trial large amplitude movements in the water to see if this intervention would improve functional mobility and performance in clients with PD. It was hoped the program will benefit the individual and their functional mobility, as well as provide contribution to the scholarship of discovery through research and understanding of the emerging are of aquatic therapy. This project also aids in laying groundwork for future scholarship with large amplitude exercise programs for people diagnosed with PD.

Although people with PD struggle with postural control and functional mobility due to their diagnosis which diminishes their ability to complete daily tasks on land, nevertheless performing exercises in an aquatic environment reduces gravity making it easier to increase occupational engagement outside of the water (Al-Qubaeissy et al., 2012; Isaacson et al., 2018;

Morris, 2010). Aquatic therapy has been suggested to be a safe and effective approach for addressing balance and postural control based upon hydrodynamic principles of hydrostatic pressure, buoyancy, viscosity, turbulence, and temperature. Aquatics can be a comfortable form of therapy that may also aid in improving endurance and strength; and by performing big and large amplitude movements may increase participation in daily activities; therefore the doctoral student researcher created an aquatic based large amplitude exercise program (Al-Qubaeissy et al., 2012; Isaacson et al., 2018; Morris, 2010).

SECTION II

REVIEW OF THE LITERATURE

Definition of Terms

Aquatic therapy, the physical treatment that takes place in a pool or other aquatic setting under the direction of a qualified healthcare practitioner (HydroWorx, 2021). Water treatment, aquatic rehabilitation, aqua therapy, pool therapy, therapeutic aquatic exercise, or hydrotherapy are all terms used to describe aquatic therapy.

Occupational Therapy, OT practitioners "help people across the lifespan participate in the things they want and need to do through the therapeutic use of everyday activities (occupations)" (AOTA, n.d.).

Parkinson's disease, is a progressive neurodegenerative disorder that causes a variety of motor and nonmotor symptoms (Dashtipour et al., 2015).

Postural control, functions necessary to maintain proximal stability, postural orientation, and a stable visual field (Bundy & Lane, 2020).

Proprioception, the perception of joint and body movements as well as position of the body, or body segments, in space (Bundy & Lane, 2020).

Social participation, a lifetime process of engaging in a variety of social occupations that include interactions and shared experiences with others, each of which contributes to healthy aging and a better quality of life (Medeiros et al., 2016).

Statement of the Problem

PD is a progressive neurodegenerative disorder that causes a variety of motor and nonmotor symptoms (Dashtipour et al., 2015). Motor impairment, such as bradykinesia; rigidity; tremor; gait dysfunction; postural instability; as well as cognitive impairment; frontal lobe

executive dysfunction; and mood problems, are all characteristics of PD (Petzinger et al., 2013). People with PD may appear to have tremors, stiffness, and problems with ambulation, balance, and coordination creating difficulty completing activities of daily living (ADL). Individuals with PD perceive their movements to be normal, but they present with abnormally small amplitude movements which limits their participation fully in ADLs. While PD is diagnosis OT practitioners frequently work with there is a deficit of practitioners working in aquatic therapy with this population. Literature states that there are programs such as LSVT BIG and PWR! that report statistically significant improvements in helping people with PD who have deteriorating motor control with daily skills by completing "big movements or power moves" (Isaacson et al., 2018; Park & Son, 2022; Parkinson Wellness Recovery, 2022). The overview of the problem was that these programs work on land but constantly battle gravity, and no one has trialed similar large amplitude movements in the water, a decreased gravity environment. The proposed solution for this project was to bring these large movements into a water program.

Aquatic therapy may be a viable option for people with PD as it allows them to move more freely while also decreasing their fear of falling by increasing their balance and functional mobility. The immersion in an aquatic setting also promotes multisensory stimulation by merging three of the sensory systems: vestibular, proprioceptive, and tactile, which can aid in the improvement of postural control (Nissim et al., 2020). Additionally, there is a therapeutic effect on the body if the water temperature is between 82-92 degrees Fahrenheit, which helps to loosen up joints, relax muscles, increase range of motion (ROM), and reduce pain (AAPT, n.d.). Aquatic Therapy provides a safe way for therapists, particularly OT practitioners to address balance, strength, postural deficits, and more in people diagnosed with PD. According to *The Occupational Therapy Practice Framework: Domain and Process* (4th ed.; AOTA, 2020), it

explains that within the domains of OT practice, OT practitioners take into account the client's range of occupations, the circumstances that influence engagement, the client's performance patterns and abilities, the demands of the occupation, and the client's bodily structures and functions; and aquatic therapy fit into this scope.

Individuals with PD encounter difficulties with their daily functions, their abilities to complete activities, and the severity of their impairments alone cannot anticipate their condition due to the influence of personal factors such as coping mechanisms, preferences, and attitudes, as well as environmental factors including social, physical, and societal aspects (AOTA, 2020; Radder et al., 2017). Currently there are a lack of OT practitioners working in aquatic therapy; however, OT practitioners are well suited to carry out this water-based exercise program.

The significance for OT deals with mobility, balance, gait, ADL, and coordination, which are all within the OT scope of practice and are the key components limited by people with PD. According to Kim et al. (2020); Martínez-Carbonell Guillamón et al. (2019); and Yamaguchi et al. (2020), a large amplitude program on land benefits individuals with PD I-II by increasing muscle performance, mobility, and functional capacity, impacting social life and quality of life. Therefore, developing a water-based program in which four feet of water is known to reduce gravity pull by 0.7 % allowing buoyant forces to push up against gravity which allows individuals to develop good gait patterns and muscle strength (Riebeek, 2012). The anticipated outcomes of this program may improve postural control or occupational engagement for people with PD stages I and II. The need for this program was to trial to see if large amplitude movements work for this population in the water. This program hypothesizes that a large-amplitude aquatic-based exercise program will help improve functional mobility and occupational performance in people diagnosed with PD.

Literature Review

Current research on OT, PD, and aquatic therapy is extremely limited; although there is research on various disorders and aquatic therapy, the focus is more on Physical Therapy (PT) interventions and outcomes. Evidence would indicate aquatic exercises may be a safer alternative than land exercises since they take place in a low-risk, supportive training environment that allows people to participate without worrying about falling (Al-Qubaeissy et al., 2012; Baena-Beato et al. (2014; Cleveland Clinic, n.d.; Morris, 2010). The water's viscosity is a fantastic source of natural resistance, and the drag of the water can help with a variety of motor training exercises by offering a manageable amount of resistance for muscle development (Masiero et al., 2018). The popularity of aquatic exercise has increased as a physical training modality for managing neurodegenerative disorders because it not only enhances functional mobility but also provides a pleasurable experience. There is a need to develop alternative exercise regimens, such as an aquatic therapy program, that are comparable to programs like LSVT BIG or PWR! for people who do not have access to these programs. Or require an alternative to land exercises due to the nature of other programs that focus on big and large amplitude movements, even with adaptations the programs can make, these programs are not adapted to water exercise. According to the evidence, rehabilitation programs for individuals with PD can be goal-oriented to help people perform and accomplish specific tasks in key areas while taking into account a number of practice variables like intensity, specificity, and complexity.

Parkinson’s disease

PD is a progressive neurodegenerative disorder that causes a variety of motor and nonmotor symptoms (Dashtipour et al., 2015). It is characterized by the loss of dopamine due to the degradation of dopaminergic neurons in the substantia nigra pars compacta (Petzinger et al.,

2013). Motor impairment, such as bradykinesia, rigidity, tremor, gait dysfunction, postural instability; as well as cognitive impairment, frontal lobe executive dysfunction, and mood problems, are all characteristics of PD (Petzinger et al., 2013). Although dopamine replacement therapy improves some motor symptoms of PD, it has less of an impact on cognitive performance (Petzinger et al., 2013). After Alzheimer's disease (AD), PD is the second most common neurological disease, with a frequency of 0.5–1% among those 65 to 69 years old, increasing to 1–3% among those 80 years and older (Kouli et al., 2018). With the older adult population, the prevalence and incidence of PD are anticipated to grow by more than 30% by 2030 (Kouli et al., 2018). The loss of nigrostriatal dopaminergic innervation is a pathological characteristic of PD, but neurodegeneration is not limited to nigral dopaminergic neurons; it also affects cells in other parts of the neural network (Kouli et al., 2018). PD is an extremely broad condition due to its wide range of pathology, and there is currently no definitive diagnostic procedure available (Kouli et al., 2018). Over the last decade, there has been a significant amount of research supporting the function of exercise in improving motor performance, which may include the enhancement of both cognitive and autonomic movement control (Petzinger et al., 2013). To improve functional capacity and decrease secondary problems, rehabilitation is used in conjunction with pharmacological and surgical treatments for PD (Abbruzzese et al, 2016). Exercise strengthens synapses and modulates neurotransmission, enhancing functional circuitry and motor learning in people with PD (Abbruzzese et al, 2016). Because of this, strengthening synapses in an aquatic setting provides a novel experience for the person, enhancing motor learning in adults. Completing exercises in a pool may help this process and increase neurotransmitters that send signals to the brain to complete movements. A majority of people who have never tried water exercises will benefit from an aquatic program that

incorporates large movements to help build up new signals to the brain created and strengthening the synapses.

Allied Medical Treatments in Parkinson's Disease

Understanding the background of the neuroscience behind PD is crucial to help create interventions and how the disease is affecting each individual. Valera and Masliah (2016) reported the absence of effective therapeutics for neurodegenerative disorders and how it is one of the most pressing concerns of this century, given that the frequency of these diseases is rapidly increasing as the worldwide population ages. The researchers explained the structures of synucleinopathies, which are defined by abnormal accumulation and distribution of the synaptic protein alpha-synuclein in the brain (Valera & Masliah, 2016). They are the second most common cause of parkinsonism and dementia in the aged population. PD, dementia with Lewy bodies, and multiple system atrophy are all disorders correlated with alpha-synuclein buildup (Valera & Masliah, 2016). Many therapeutic possibilities for synucleinopathies are being studied in preclinical models and in the clinic; however, only palliative medicines that address dopaminergic deficiencies have been licensed to date, and no disease-modifying strategies are available (Valera & Masliah, 2016). Their critiques of unknown knowledge of synucleinopathies and human pathology are needed to be discovered to assist people with these diagnoses to increase the effectiveness of medications and potential therapies (Valera & Masliah, 2016). Despite these critiques, this research demonstrated that having a broad approach to treatment for people with PD would be beneficial to research and potential research of the treatment of synucleinopathies.

OT practitioners and PT practitioners can specialize in neurorehabilitation to assist people with PD through motor skills and ADLs to achieve optimal performance. According to

Petzinger et al. (2013), goal-based motor skill training is used in PD exercise treatments to stimulate neural circuits involved in motor learning. PT promotes learning through guidance and reinforcement, as well as motivation to accomplish beyond one's perceived capabilities (Petzinger et al., 2013). Individuals with PD become more cognitively involved as they perform and acquire previously automatic and unconscious movements and skills (Petzinger et al., 2013). Aerobic exercise, which is thought to be beneficial for improving blood circulation and facilitating neuroplasticity in the elderly, will help persons with PD enhance their cognitive function (Petzinger et al., 2013). Through experience-dependent neuroplasticity, exercises that combine goal-based training with aerobic activity have the potential to increase both cognitive and automatic components of motor control in people with mild to severe illness (Petzinger et al., 2013). Nevertheless, in order to close significant gaps in knowledge, more research is required. Non-invasive neuroimaging studies are necessary for particular to determine the relative impact of goal-based or aerobic exercise alone or in conjunction, as well as their impact on brain function, connectivity, and motor behavior (Petzinger et al., 2013). Despite these criticisms of needing more research, it would be beneficial for an OT to be on the team to help accomplish this, as it is necessary to keep a holistic view on this research to help increase a person with PD quality of life and how aerobic exercise can be beneficial. Understanding how other forms of interventions and exercise could play an impact on neuroimaging could be a new wave for research and how it can increase skills for people with PD.

Current medical care is only moderately effective in treating the symptoms of PD, according to this narrative review by Radder et al. (2017). PT and OT, as part of comprehensive multidisciplinary care, aim to assist individuals with PD in dealing with the effects of their disease in daily activities (Radder et al., 2017). To create this seamless flow of PT and OT, there

needs to be complete awareness of each other's skills, as well as good and timely communication (Radder et al., 2017). The diagnostic results, therapy goals, and treatment plan may be included in the shared information. Contradictory interventions can be avoided, and therapy by OT, PT, and other experts may be scheduled in time, when possible, to lessen the patient's burden (Radder et al., 2017). Speech language pathology therapy (SLP), OT, and PT all provide essential treatments that help improve function and quality of life for people with PD. There are successful pharmacological, surgical, and therapeutic treatments for managing the symptoms of PD, but no treatments exist to delay, stop, reverse, or cure the neurodegenerative changes associated with the disease (Radder et al., 2017). However, having a multidisciplinary approach to assist in keeping up with daily routines is very beneficial for the quality of life for someone with PD. Finding another environment, such as a pool, to perform exercises in may be deemed beneficial for people with PD.

Aquatic Therapy

A great way to address some of these deficits that people with PD are having is through aquatic therapy. This is a distinctive approach to deliver OT services because it aids in lowering joint compression forces, may lower inflammation, and offers feedback for posture improvement. When used in a therapeutic setting, the resistance of water can offer a secure setting for addressing balance, strength, and postural impairments (Cleveland Clinic, n.d.). For clients who have difficulty in a traditional setting, aquatics may be a comfortable form of therapy that may also aid in gaining endurance and strength. Al-Qubaeissy et al. (2012), found that clients who received aquatic therapy for the treatment of Rheumatoid Arthritis (RA) gained beneficial effects that improved their health status by reduced pain scores compared to the control group. Due to the reduced pain, these clients enhanced their quality of life. Evidence

indicates that exercise can reduce pain, disability, time away from work, and improve quality of life, according to a controlled clinical study on aquatic rehabilitation by Baena-Beato et al. (2014).

Alternative Diagnoses benefitting from Aquatic Therapy

Comprehension of the versatility of aquatic therapy regardless of practitioner license will help identify aspects to bring into interventions for other populations such as sensory disorders; limited ROM; weakness; poor motor control; pain; spasticity; balance deficit; orthopedic; polytrauma; and many more population groups which OT practitioners are well educated in.

Little evidence was found on the differences between aquatic-based and land-based fall prevention programs. A systematic review done by Kim et al. (2020) compared articles focusing on the effects of aquatic and land exercise on dynamic balance in older adults. They compared studies of older adults over the age of 65 years with no restriction on the injury or disorder type, setting, and history of falls, one dynamic balance outcome and who were part of randomized control trials (Kim et al., 2020). The outcome measurements in the meta-analysis were put into three categories, "(a) dynamic steady-state balance (e.g., 5-m walk test, 10-m walk test, backward tandem walk), (b) proactive balance (e.g., FRT; Functional Reach Test, TUG; Timed Up and Go test, 8- ft up-and-go test), and (c) balance test batteries (e.g., BBS; Balance Berg Scale and BOOMER; Balance Outcome Measure for Elder Rehabilitation)" (Kim et al., 2020). Their results suggest that the studies with aquatic exercise displays comparable effects on dynamic balance in older adults when compared to land exercises (Kim et al., 2020). Meaning aquatic exercises may also be a safer alternative to land exercises because the water provides a safe, low-risk, and supportive training environment which can lead to older adults participating in exercise programs without the risk or fear of falling (Kim et al., 2020).

Martínez-Carbonell Guillamón et al. (2019) in a systematic review compared studies looking at weakness, balance deficits, and gait deficits as the most important individual risk factors for falls. Strength, flexibility, balance, and reaction time are the most modifiable internal risk factors for falls, which provide a rationale for different exercise interventions to reduce falls in the elderly (Martínez-Carbonell Guillamón et al., 2019). Evidence indicates rate of future falls can be reduced by improving modifiable internal risk factors such as balance, strength, and flexibility by changing up the environment from land to water (Martínez-Carbonell Guillamón et al., 2019). Aquatic exercise offers a safe, low-impact, and low-weight bearing atmosphere for exercise. An individual may focus on developing physical gains because the risk of falling is eliminated (Martnez-Carbonell Guillamón et al., 2019). Not only are there safety benefits, but a program immersed in water may also offer an alternative to repetitive, conventional exercise that can increase the client's want for rehabilitation goals (Martínez-Carbonell Guillamón et al., 2019). Martínez-Carbonell Guillamón et al. (2019), studied a population that consisted of healthy older adults between 60 and 80 years old. The types of exercises performed were strength training of the upper and lower extremities using static and dynamic balancing exercises (Martínez-Carbonell Guillamón et al., 2019). They found that the use of aquatic exercise may enhance the negative effects of aging which can improve the risks of falling by changing the environment.

There are four main systems that contribute to balance control: sensory factors, musculoskeletal factors, neuromuscular strategies, and anticipatory control (Morris, 2010). Each have their own examples on how these systems work in the body. The sensory system helps with the ability to perceive and respond to vestibular, visual, and somatosensory stimuli (Morris, 2010). The musculoskeletal system assists with muscle tone, strength, and ROM (Morris, 2010).

The neuromuscular system assists with using suitable postural strategies in an opportune and efficient manner (Morris, 2010). Lastly, anticipatory control helps adjust sensory and motor systems in anticipation of these postural demands based on prior knowledge and skills people have. According to Morris (2010), balance problems and injuries from falls are significant public health issues that cause significant financial hardship and unnecessary misery. Morris, with his background as a PT practitioner, noted that the water is an effective environment to address balance dysfunction through rehabilitation and fitness activities (Morris, 2010). Thus, the importance of addressing balance with the emphasis on postural control in an aquatic program to address these deficits.

It is anticipated a large-amplitude aquatic exercise program will help clients gain the strength needed to complete activities and tasks outside of the water. The water will help minimize falls while completing exercises, giving the client confidence in performing movements. This will then translate into strengthening core muscles, activating synapses, and therefore will increase functional mobility leading to a happier life of modified independence. Aquatic therapy has been suggested as a safe and effective approach when addressing balance and postural control when using hydrodynamic principles (hydrostatic pressure, buoyancy, viscosity, turbulence, and temperature) (Morris, 2010). Some examples of interventions used include Watsu, Ai Chi, Bad Ragaz Ring Method (BRRM), Halliwik, Task-type training approach (TTTA). Watsu provides slow rhythmic rotational movements that reduce hypertonicity through tone-inhibiting vestibular stimulation (Morris, 2010). Ai Chi promotes relaxation from diaphragmatic breathing which stimulates the parasympathetic nervous system (Morris, 2010). BRRM is influenced by proprioceptive neuromuscular facilitation (PNF) facilitating passive or active movements (Morris, 2010). Halliwik concept is a neurotherapeutic facilitation

rehabilitation technique (Morris, 2010). TTTA is working functional positions with functional activities (Morris, 2010).

Pérez-de la Cruz et al. (2015), focused on the effects of Ai Chi fall prevention for patients with PD. People who have been diagnosed with PD have a high incidence of falls due to the decline of both static and dynamic balance (Pérez-de la Cruz et al., 2016). Ai Chi was created in 1996 in Japan and is based on tai chi and qi qong (Pérez-de la Cruz et al., 2016). Instructors of this intervention explained and demonstrated a slow, coordinated combination of movements of the limbs and trunk, while the participants repeated the movements while standing in a pool (Pérez-de la Cruz et al., 2016). Since gait disorders are a challenge that involve a high risk of falls, disability, and physical decline in patients with PD, aquatic therapy is one technique to assist in a safe environment. This study done by Pérez-de la Cruz et al. (2015), found that Ai Chi is a promising and feasible aquatic treatment for improving pain perception, balance, and functional capacity in people diagnosed with PD which can be incorporated through a large-amplitude exercise program in the water.

Another population this program can work for is individuals who have musculoskeletal disorders (MSDs). MSDs are one of the most common health problems and are a significant burden on health and wellness (Moreira et al., 2020). A randomized control trial done by Moreira et al. (2020), discussed how side-effects of a fall can include fear of falling and reduced fall risks awareness, which further influences muscle performance, mobility, and functional capacity, impacting social life and quality of life. Due to the natural buoyancy and viscosity of water, the decrease in the joint load provides a safe and protective environment to do aquatic exercises, creating a safe and enjoyable way to improve physical functioning in older adults with or without MSDs (Moreira et al., 2020). Fall risk awareness, which may be a crucial strategy to prevent

falls, is correlated with the perception of the risk variables included in the environment, behavior, and daily living activities, according to Moreira et al. (2020). After participants completed a 16-week program of aquatic exercises, they found that people's perception changed and increased in safety and self-confidence (Moreira et al., 2020). However, this also led to improved functional capacity and social quality of life, which resulted in a reduced fear of falling and diminished fall risks (Moreira et al., 2020) All this information is important when addressing PD, as falls may happen frequently leading to MSDs. The hope in a large-amplitude aquatic based program will help strengthen the participant to decrease risk of falling that leads to secondary complications.

Aquatics and Parkinson's Disease

Due to the abundance of research on the benefits of aquatic exercise for various conditions, studies exploring the potential benefits of aquatic therapy for individuals with PD have emerged. Yamaguchi et al. (2020), conducted a controlled quasi-experimental clinical trial with blind assessors, recruiting male and female participants diagnosed with PD at Hoehn and Yahr stage 1 to 4, and gave medical certificates for aquatic physical therapy. The participants were divided into two groups: the control group, which did not engage in aquatic activities, and the experimental group, which underwent aquatic therapy. The program involved 32 appointments of 50-minute duration twice a week, comprising functional exercises based on the principles of specificity and progression, where aquatic motor skill learning phases progressed in complexity. The researchers employed functional assessments conducted on land, including the Unified Parkinson's Disease Rating Scale (UPDRS), walking speed test, Mini BESTest, Five Times Sit to Stand Test for ADL, and motor skill parts, conducted before, after, and four months post-aquatic therapy. The results indicated that aquatic exercises improved the ability to sit and

stand among individuals with PD, as observed in land-based studies. The study supported the hypothesis that environmental stress can increase strength, endurance, and power, leading to improvements in standing and sitting up. Despite critiques in scientific literature that did not find improvements in body balance, researchers considered the aquatic environment as a safe strategy to mitigate fall risk by improving trunk mobility and transferring body weight away from the center of mass in different positions. These results suggest that aquatic therapy could be a promising modality to improve functional mobility and reduce fall risk in individuals with PD.

Increasing awareness of body balance, posture, and strength, Masiero et al. (2018), aimed to conduct research based on a retrospective study to explore how aquatic physiotherapy could improve quality of life and reduce postural instability of people with fall risks and how this could relate to people with PD. Over the course of four weeks, the rehabilitation program consisted of 45-minute sessions of practical re-education and kinesitherapy in the thermal pool, held twice a week on non-consecutive days (Masiero et al., 2018). During each session, the patients were also provided educational and preventive advice. Therapists provided nutrition, health, education, and cognitive behavioral guidance to the patients (Masiero et al., 2018). The researchers excluded patients with depression along with other criteria most research excludes such as inability to walk independently; an implant for deep brain stimulation; severe cardiac; pulmonary; or orthopedic diseases; and co-morbidities (Masiero et al., 2018). The research concluded that aquatic thermal physiotherapy was found to be safe, with no adverse events, extreme fatigue, or exacerbation of PD symptoms (Masiero et al., 2018). The program was enjoyable to the participants and each assessment demonstrated significant improvement with all p-values less than $p = 0.05$ (Masiero et al., 2018). Despite the critiques of the low number of participants, the researchers found that aquatic rehabilitation is a useful strategy for people with PD and having a

program with a long-term follow-up would be beneficial to see all effects of the aquatic environment.

Carroll et al. (2017) performed a six-week study using a single-blinded randomized controlled trial design to assess the impact of aquatic exercise therapy on gait variability and disability, in comparison to standard care, for individuals with PD in a community-based hydrotherapy pool. With the growing evidence indicating that physical activity may have both pleasurable and neuroprotective effects, there had been a recent surge in interest in aquatic exercise therapy as a potential treatment option for PD (Carroll et al., 2017). To maintain sustained participation in exercise over the course of the disease, the participants with PD were encouraged to engage in regular physical activity and explore new types of exercise as they progress (Carroll et al., 2017). In addition to skill-building training, strength training, cycling, tai chi, dancing, progressive resistance training, and boxing, aquatic therapy represents another form of exercise (Carroll et al., 2017). Aquatic therapy allows individuals with PD to move more freely, reduce their fear of falling, and enhance their balance and functional mobility. There are currently minimal evidence/small pilot trials to support the use of water treatment to improve gait in individuals with PD (Carroll et al., 2017). Aquatic therapy was shown to be feasible and safe in the research, with no side effects, excessive exhaustion, or exacerbation of PD symptoms observed (Carroll et al., 2017). There were no notable significant differences between the groups in gait variability in respect to step length, step width, or step duration, contrary to preconceptions (Carroll et al., 2017). For individuals with PD, walking in water may be less challenging due to the heightened frictional forces created by water's resistance to movement, as well as a decrease in effective body weight caused by buoyancy forces (Carroll et al., 2017). Participants were difficult to achieve, according to the researchers; with a 48% acceptance rate,

more than half of the eligible individuals were rejected due to the inability to swim, with few reporting a high level of anxiety in water (Carroll et al., 2017). Despite the criticism made by the researchers, this form of exercise in the water demonstrated beneficial for the people willing to participate in the study, since more research needs to be done, creating a high amplitude exercise program in the water would be a significant step in obtaining more research on this area.

Cugusi et al. (2019), in a systematic review and meta-analysis of randomized controlled trials looked at the effects of aquatic exercise on disease severity with participants diagnosed with PD. They compared studies who used an aquatic settings and beneficial properties of the water, combined with the warmth of the water to help decrease stiffness and pain (Cugusi et al., 2019). The viscosity of the water is an exceptional origin of inherent resistance, and the resistance caused by the water's viscosity can assist in various motor training tasks by providing an adaptable resistance for muscle reinforcement (Cugusi et al., 2019). Due to its ability to enhance functional mobility whilst also being enjoyable, aquatic exercise has become a very popular form of physical training in the management of neurodegenerative disorders (Cugusi et al., 2019). Because of the therapeutic characteristics of water, as well as the warmth of the water, they used an aquatic setting to assist reduce stiffness and discomfort. From this knowledge of information, Cugusi et al. (2019), implies that the effect of aquatic exercise has a beneficial outcome on disease severity, (non-)motor impairments, activity performance, decrease fear of falling. All of this may lead to an increase in quality of life for people with PD which enhances the need for this aquatic program.

Water's viscosity is an effective natural source of resistance, and viscous drag can help with a variety of motor training tasks by providing a comfortable resistance for muscle growth (Cugusi et al., 2019). Aquatic therapy has become a prominent kind of physical training in the

management of neurodegenerative illnesses due to its capacity to improve functional mobility while also being pleasurable (Cugusi et al., 2019).

The aquatic workout regimen was comprised of three phases: a preliminary warm-up phase, a central major phase of aquatic endurance training, and a final cool-down phase, which were performed in a supervised group class led by a physiotherapist (Cugusi et al., 2019). The central portion of aquatic exercise training in two investigations was characterized by a series of Ai Chi exercise movements, which is a type of aquatic exercise utilized for pleasure, relaxation, fitness, and physical rehabilitation that combines trunk rotation, standing balance, and single-leg balance (Cugusi et al., 2019). The benefits of incorporating aquatic exercise with Ai Chi is that these movements are performed within the water, increasing balance, posture, and the movements can be slow and large to provide proprioceptive feedback from the water to increase muscle strength. The Ai Chi movements can be similar to exercises performed in the water; however, there is smooth transitions between movements to increase challenge for participants. According to the results of the study, they found that clinicians or patients who have the option of choosing between different rehabilitation protocols may prefer aquatic exercise to land-based exercise, particularly if they have relevant motor impairments, such as shuffling gait; start hesitation; freezing of gait; impaired gait propulsion; and difficulty turning; which may increase the risk of falling during exercise on land (Cugusi et al., 2019). It was gathered from this study that there needs to be more research on insurance and cost of aquatic therapy to help this population succeed in daily life activities through this form of rehabilitation, as well as how OT can be involved in studies like this one. However, this information helped the doctoral capstone researcher to create an aquatic program that has a warm up and cool down portion of the program.

According to Volpea et al. (2020), underwater gait training has been presented as a unique rehabilitative technique for treating axial difficulties in patients with PD, including balance and gait impairment. However, the cause of improvement in treating this is unknown. The goal of this study was to evaluate gains in muscle activation in the lower extremities in a group of Parkinson's disease patients who had undergone underwater gait training (Volpea et al., 2020). The researchers used a surface electromyography system (sEMG), two force plates, and a motion capture device to collect the electrical activity of four muscles bilaterally (Volpea et al., 2020). The gait cycle was used to synchronize all signals which included the recording of the Rectus Femoris (RF), Tibialis Anterior (TA), Biceps Femoris (BF), and Gastrocnemius Lateralis (GL) sEMG activity (Volpea et al., 2020). The peak of the envelope (PoE) and its occurrence with regard to the gait cycle were extracted using the average of each signal (PoPE%) (Volpea et al., 2020). The experiment's findings demonstrated that patients' muscle recruitment patterns improved towards normal. With the exception of BF, the POPE% following underwater gait training was comparable to that of one of the controls (Volpea et al., 2020). The muscle co-activation plots did not demonstrate any improvement in line with the muscle activation (Volpea et al., 2020). The implications of this suggest that the increase in muscle activation with underwater gait training in persons with PD may be attributable to a reorganization at the executive level rather than at the command level (Volpea et al., 2020). The study concluded that there needs to be more research on different forms of rehabilitation for people with PD; this exemplifies the importance of how OT can be a great opportunity to add to scholarship and discovery in this field, helping create protocols for increased underwater gait training in a holistic form. This informs that the OT profession has a wide variety of opportunities to assist in the management of PD symptoms.

Occupational Therapy

OT practitioners "help people across the lifespan participate in the things they want and need to do through the therapeutic use of everyday activities (occupations)" (AOTA, n.d.). In randomized controlled trials conducted by Pergolotti et al. (2018), looked at the benefit of OT services. OT was proven to be cost-effective in reducing falls in persons with stroke or dementia, as well as when delivered as a preventive intervention, in these investigations (Pergolotti et al., 2018). The majority of population-based research on inpatient rehabilitation services has targeted post-acute care, hospital readmission, or geographic variability in effectiveness (Pergolotti et al., 2018). Despite the upfront expense of OT, which may serve as a barrier to accessing such services due to varieties of insurance plans, these interventions ultimately prove to be a cost-efficient solution by lessening disability and improving quality of life (Pergolotti et al., 2018). Sadly, numerous patients who could benefit from outpatient OT miss out on these opportunities. OT costs are currently determined by physicians and Medicare reimbursements for uninsured and Medicare-insured patients (Pergolotti et al., 2018). This includes amounts reimbursed by Medicare and billed to the patient. Patients lacking insurance coverage may face higher treatment costs, potentially exceedingly twice the Medicare reimbursement rates for the same therapies (Pergolotti et al., 2018). Economic stress resulting from higher costs may lead to lower adherence to treatment and increased risk of disability over time (Pergolotti et al., 2018). Previous studies have indicated that when treatments become excessively expensive, patients may choose to forgo necessary therapies, despite their medical requirements (Pergolotti et al., 2018). This study suggested future research with billing codes is needed to explore the necessity for, use of, and impact of the therapy cap on OT (Pergolotti et al., 2018).

Occupational Therapy and Parkinson's Disease

It is within the scope of practice for OT practitioners to be working with people who have PD. Doucet et al. (2021) conducted a systematic review to determine which interventions that have been utilized to help individuals with PD enhance or manage their ability to do ADLs, rest, and sleep. Because impairments in ADLs have been correlated to greater rates of hospitalization; longer hospital stays; admission to long-term care; and increased mortality rates; ADL performance is critical (Doucet et al., 2021). Prior research published between January 2003 and May 2011 prompted this systematic review, which focused on any interventions that were within the scope of OT, regardless of outcome (Doucet et al., 2021). Although the evidence for various outcome domains (motor performance, balance, cuing methods, and wellness efforts) was summarized, no studies using outcome measures related to the effectiveness of interventions to improve ADL performance in adults with PD were available at the time (Doucet et al., 2021). The trials were divided into four intervention themes: rehabilitation, physical exercise, alternative therapies, and cognitive behavioral therapy (Doucet et al., 2021). Minimal research of standard OT interventions such as ADL training; environmental or task modifications; occupational performance interventions; functional mobility training; and LSVT BIG programming were conducted during their research and findings (Doucet et al., 2021). Developing a program that includes a number of metrics in an aquatic setting could be beneficial for future research.

The AOTA Evidence-Based Practice Guidelines Series prepared a table of systematic reviews from the Research Opportunities in the Area of Adults with Neurodegenerative Diseases (2015). The table lists individual interventions and states whether there is strong evidence to support the intervention or whether there are moderate, mixed, or few studies that support it,

making it a priority area for future research. Within the table, the category for engaging in exercise and physical activity to improve performance abilities and occupational performance for Amyotrophic Lateral Sclerosis (ALS) reveals that aquatic therapy is an area for future research to be conducted. However, there is no mention of aquatic therapy under PD. This illustrates that there is a lack of research on aquatic therapy, OT, and PD with the need for greater research stemming from the fact that aquatic therapy is part of the OT scope of practice and helps to enhance energy and lessen the need for assistance with multiple forms of ADLs following therapy.

Chapman and Nelson (2014), conducted a study that relied on a case analysis of an individual participant who had PD and displayed indications of slow movement on both sides of the body, shaking, stooped and uneven posture, an unsteady gait characterized by occasional periods of immobility, mild cognitive impairment, feelings of sadness, a lifestyle with limited activities, and a personal account of experiencing around one fall per month. The outcomes of the study were deemed to be incredibly useful to OT practitioners when selecting activities for those who have been diagnosed with PD (Chapman & Nelson, 2014). When choosing activities, understanding the typical characteristics of this disease can be beneficial. Patients with PD can be included in activities that promote skill development through the patient's active participation (Chapman & Nelson, 2014). Working collaboratively with patients can help OT practitioners ensure that the goals and strategies used are meaningful to each individual and is essential to include caregivers in the therapeutic intervention. The effectiveness of interdisciplinary analytical reasoning is maximized by receiving feedback on performance and applying the recommendations through constant practice (Chapman & Nelson, 2014). By conducting an overall evaluation of the patient's abilities and constraints in both their home and community

environments, utilizing behavioral therapies, incorporating adaptive equipment, and implementing environmental modifications, falls can be prevented or eliminated, leading to an improved quality of life for individuals with PD (Chapman & Nelson, 2014). One critique is that this research lacked options for the patients on what activities they can do, such as aquatic therapy. Despite these critiques, it was discovered that creating interventions meaningful to the individual will help them succeed in their goals.

The importance of a person's environment when completing tasks can demonstrate different outcomes of occupational performance. Summa et al. (2015), conducted an experiment to study a total of seven people with idiopathic PD. They focused on numerous aspects of movement performance to determine the effect of exercise (Summa et al., 2015). Looking at movement path; movement time; and average absolute acceleration for each movement; and target distance, which is a measure of task complexity that was automatically modified at each goal set (Summa et al., 2015). The researcher's reasoning is that bradykinesia can be alleviated with repetitive exercise that focuses on large-amplitude movements (Summa et al., 2015). Their findings were inconclusive as to whether the observed outcomes were related to increased energy or familiarity with the task of reaching (Summa et al., 2015). Despite the critiques, they understood that reaching is a form of repetitive movement is necessary, with and without a therapist present to complete daily tasks. This concludes the importance of reaching type tasks on ADLs, performing these types of movements in a safe environment, such as a pool, will help patients decrease the fear of falling and increase the ability to reach bigger and farther.

Programs such as LSVT BIG, which is a four-week, four days a week, exercise program for individuals with PD, consisting of 16 one-hour sessions, can be beneficial to increase and maintain functional movements. The in-person or online program consist of teaching techniques

including pre-recorded lectures, nearly one hundred videos, and interactive case study presentations (LSVT Global, 2022). Knowledge review questions and video-led practice times ensured the highest levels of learning (LSVT Global, 2022). Pre-assessment and certification exams are administered in-person or online as part of the training (LSVT Global, 2022).

Ebersbach et al., (2014) compared a typical LSVT-BIG program to a two-week short protocol consisting of ten sessions with identical exercises. The research resulted in patients who followed the conventional LSVT BIG regimen and those who had a lower number of training sessions having similar changes in motor assessments (Ebersbach et al., 2014). These findings oppose an expected dose-dependency of therapy that would have favored the standard LSVT BIG protocol (Ebersbach et al., 2014). The reduced training intensity of the short program demonstrated not sufficient enough to maintain the same goal a typical LSVT BIG program (Ebersbach et al., 2014). Despite these critiques that clinician-rated Unified Parkinson's Disease Rating Scale (UPDRS) scores and laboratory motor evaluations produced similar results, it was recommended that LSVT BIG be delivered according to the standard protocol because shorter training routines are less likely to achieve patient-perceived improvement (Ebersbach et al., 2014). Keeping a program in line with standard protocols of evidenced-based programs will help guide more effective and reliant therapy.

Dashtipour et al. (2015), conducted a prospective, double-blinded, randomized clinical trial that included eleven individuals with early-mid stage PD. Over the course of four weeks, both groups got 16 one-hour supervised training sessions. The UPDRS, Beck Depression Inventory (BDI), Beck Anxiety Inventory (BAI), and Modified Fatigue Impact Scale (MFIS) were used as outcome measures (Dashtipour et al., 2015). Recent research has shown that exercise routines can help people with PD improve both motor and nonmotor symptoms

(Dashtipour et al., 2015). According to the findings, this was shown to be effective; however, the study also emphasizes the necessity of developing alternative exercise regimens based on LSVT BIG therapy for patients who do not have access to outpatient LSVT BIG therapy (Dashtipour et al., 2015). From this research, it was realized that a program based in an aquatic environment to increase performance would be beneficial as well as keep up patients' skills they developed in LSVT BIG program. This would not only improve the understanding of the impact of exercise on neurodegenerative disorders but help improve clinical skills in managing people diagnosed with PD who have multiple complications.

Farley et al. (2008), studied more effects of LSVT BIG and LSVT LOUD on patients with PD. They found that the capacity of training a single global motor control parameter to have optimum functional significance while enhancing clinical efficiency is significant (Farley et al., 2008). Critiques suggested is more research on LSVT BIG and LSVT LOUD across multiple motor systems such as dexterity; balance; speech; reaching; facial expression; swallowing; articulation; and respiration to understand the cross-system interactions among these systems (Farley et al., 2008). It is discovered that the use of exercise as a disease-modifying therapeutic option upon immediate diagnosis would be beneficial. Once starting treatments, incorporating the need for aquatic therapy would provide a challenge however keeping the patient always working for more to increase functionality.

PD symptoms over time diminish the ability for people to complete their daily tasks. The consistency of amplitude and speed of executed movements is dependent on proprioceptive input, which has been demonstrated to be impaired in PD. A significant pathological mechanism of bradykinesia may be abnormal processing of proprioceptive input (Peterka et al., 2020). Thirty people with PD were recruited from the University of Würzburg's Department of Neurology.

Exclusion from the study was due to neurological or psychological issues other than PD and dopaminergic medication was provided (Peterka et al., 2020). In addition, 15 age-matched healthy volunteers were enlisted as a control group (Peterka et al., 2020). After LSVT BIG therapy, there was a noticeable difference in abnormal processing of proprioceptive information, as well as an increase in quality of life as measured by the PDQ-39 (Peterka et al., 2020). Proprioceptive impairment in PD is believed to be caused by abnormal processing of proprioceptive input on a subcortical and/or cortical level, despite the fact that muscle spindles in PD have a normal appearance (Peterka et al., 2020). Creating a program that focuses on other factors of proprioception, such as being in an aquatic environment, will provide more knowledge on this topic of how possibly perception and integration on somatosensory input could increase these pathways or help understand how sensorimotor impairment in people with PD works.

Even though there has been more recent research on PD, Farley and Koshland (2005), hypothesized that training of large amplitude motions in the upper and lower extremities will help reduce bradykinesia and hypokinesia with people diagnosed with PD. Long/big amplitude movements have been observed to have a higher reduction in speed than brief/small amplitude movements, implying that velocity may saturate or disproportionately scale at large amplitudes (Farley & Koshland, 2005). The article's main finding demonstrated increases in amplitude and speed varied depending on disease severity, with mild PD patients showing the most improvement (Farley & Koshland, 2005). Amplitude-based behavioral intervention in patients with PD appears to be a simple target that can be used in a variety of situations for a variety of tasks and leads to enhanced speed–amplitude scaling relations in the upper and lower extremities (Farley & Koshland, 2005). This research helped frame many programs incorporating large

amplitude movements for people with PD. This research helps frame the need for an aquatic-based program to assist people with PD to increase functional mobility in their daily lives.

Benefits of Aquatic Occupational Therapy and Parkinson's Disease

Previous systematic reviews and research stated above suggest that aquatic exercise is safe and beneficial for people with PD. It improves aspects of activity performance, quality of life, and balance; however, safety criteria were frequently under-reported. These reviews, on the other hand, contained a number of weaknesses, including the inclusion of non-randomized trials and the lack of a meta-analysis. Given how frequently this type of exercise is utilized in the management of PD-related dysfunction, the impacts of aquatic exercise in patients with PD still need to be thoroughly examined.

Statement of Purpose

The purpose of this program was to develop, implement, and trial large-amplitude movements in the water and increase functional performance and mobility with everyday tasks in individuals with PD. The objective was that the characteristics of the aquatic setting can enable people with PD who have postural instability, a high risk of falling, weakness, and gait disturbance to exercise efficiently when doing so on land would be difficult or unsafe (Abbruzzese et al, 2016; Petzinger et al., 2013; Yamaguchi et al., 2020). Each participant was told that this program may assist in decreasing motor impairments (shuffling gait, start hesitation, freezing, festination, impaired gait propulsion, and difficulty in turning) to increase performance in ADLs outside the water. The outcome was to develop and create an aquatic based program because gravity makes exercise and movement difficult, while determining feasibility and if people would enjoy this type of exercise.

Theoretical Framework

This program was grounded in theories that involve sensory integration, motor learning, biomechanics and the Person-Environment-Occupational Performance Model (PEOP). The interventions targeted the client's goals in a meaningful and hands-on manner within an aquatic environment (Baum et al., 2015). The profession of OT integrates with occupational science by "provid[ing] a way of thinking that enables an understanding of occupational, the occupational nature of humans, the relationship between occupation, health, and well-being, and the influences that shape occupation." OT practitioners use a unique lens when examining what a client needs (World Federation of Occupational Therapist [WFOT], 2012b). This model takes into account three ideas: the individual, the environment they are in, and the activity (or task) they are performing (Baum et al., 2015). Personal traits, such as one's mental and physical makeup, are what define a person (Bass et al., 2015, p. 5 as cited in Baum et al., 2015). Environmental factors are the external circumstances that influence behavior, such as nature, culture, and technology (Bass et al., 2015, p. 5, as cited in Baum et al., 2015). Finally, occupations are people's daily responsibilities or activities that improve their overall well-being (Bass et al., 2015, p. 5, as cited in Baum et al., 2015). These three elements are taken into consideration in order to comprehend how they either promote or restrict the individual's engagement in everyday activities, performance, and general well-being (Baum et al., 2015).

Occupational performance is the outcome of the PEOP model, and what was hoped to be received with this program. Doing so by increasing postural control, functional mobility, and quality of life through aquatic exercises can increase performance outside of the water. Taking into account the person's intrinsic factors; physiological, cognitive, psychological, neurobehavioral, and spiritual, helped create better goals for the client following the program

(Wong & Fisher, 2015). According to Wong and Fisher (2015), extrinsic factors such as physical, cultural, social, societal, and economic helped develop this program by understanding who has easy access to a pool and how this program can be developed for individuals who can continue what they learned in this program outside and into their daily life. The occupational factor helped the client accomplish their goals and increase the ability to complete daily activities they want to do once outside of the water. The client's performance in this program was developed through the outcome of the aquatic environment, their occupational factors, and their personal (intrinsic and extrinsic) needs.

Overall, the PEOP model is a client-centered approach, top-down focus on the occupation, and holistic when choosing appropriate interventions (Wong & Fisher, 2015). What was important through this model was understanding how the aquatic environment can either give extra support to a client who needs their exercises to be gravity eliminating or giving them more resistance through the water to increase challenge to get stronger and increase their balance.

SECTION III

METHODOLOGY

Study Design

This project was a feasibility study of pre- and post-measures to determine if this type of program was possible for people with PD stages I and II. There were a limited number of participants; however, a foundation was laid to guide future research projects within this this emerging interventional arena. Following IRB approval, IRB #: UNLV-2022-478, the recruitment process was from December 2022 through January 2023. Once eligibility was confirmed by principal investigator (PI) and/or Site Mentor, the doctoral student researcher obtained verbal consent via phone prior to the first session. The participant was asked if they understood and was able to ask follow-up questions throughout the phone interview; the call was not recorded. On the first visit to Hands on Rehab and Aquatics, the consent form was reviewed once again, and a hard copy was provided to the participant in a quiet and private office space to sign the informed consent. A call to her doctor for medical clearance to participate happened during the recruitment process. The plan was up to five participants recruited by flyers handed out and posted at Hands on Rehab and Aquatics to broaden the sample. The hope was to capture a variety of participants in age, gender, and disease severity. The recruitment process and enrollment were purposely sampled for these characteristics. Recruitment was through the capstone placement site at 7921 Professional Circle, Huntington Beach, CA 92648, in which a signed EAA was on file with the university.

The inclusion criteria to participate in this program was to be 18 years or older; English speaking; a letter provided from their physician to participate in this program; PD stages I-II; willing to receive therapy in a pool environment consisting of up to 89-90 degrees Fahrenheit;

and normal physiological status while in the pool. The exclusion criteria were if they do not have access to a telephone and/or computer; other issues are present that preclude meaningful participation; any cognitive decline noted by physician or primary care provider; contraindications that are commonly understood in aquatic therapy.

Hands on Rehab and Aquatics has been providing superior therapy services in Orange County since 2002 and consists of PT, OT, massage therapists, an acupuncturist, and chiropractic services. They take a variety of insurance types for reimbursement of services; however, they have reasonable cash rates as well. They serve a diverse population consisting of neurological, musculoskeletal (MSK), post-surgical, pediatrics, pelvic floor, and geriatrics (Hands on Rehab and Aquatics, Inc, n.d.). The services they offer are aquatic therapy, physical therapy, hand therapy, Pilates, pediatrics, massage, red cord, pelvic health, acupuncture, and telehealth appointments (Hands on Rehab and Aquatics, Inc, n.d.).

Data Collection

The Timed Up and Go (TUG) and the Parkinson's Disease Questionnaire-39 (PDQ-39) were the pre- and post-measures utilized to assess functional mobility and quality of life of the participant. The TUG is a 3-minute test consisting of rising to stand from a chair, walking 10 feet and returning to sit. The TUG assessment was used as it valid for individuals with PD following a land-based exercise program with reliability and excellent test-retest reliability (ICC = 0.80), excellent interrater reliability (ICC = 0.99) and validity with excellent validity ($r = -0.47$, $p = 0.04$) according to Shirley Ryan AbilityLab (2013b). The PDQ-39 is a 39-question assessment where the participant rates their perceived ability on aspects of daily life. The self-report Quality of Life with PDQ-39 with high test-retest reliability (0.68-0.95), four-weeks apart test-retest reliability (ICC = 0.79) and high validity ($r = 0.63$) according to Shirley Ryan AbilityLab (2014).

These assessments were used for pre and post measures to see if there were any changes in performance. The data collection of these assessments was used through Excel, Qualtrics XM, and SPSS. The information and results from the PDQ-39 and TUG test were put into the University of Nevada, Las Vegas (UNLV) free tool, Atlas.ti, for students to analysis the data through Paired t-test of survey pre- and post-measures. The analysis of the data was used to compare the assessments to see if there was any improvement. The data was analyzed to see if there was a significant difference with the standard deviation and mean from both pre and post measures.

Prior to the beginning of the capstone experience, the doctoral student researcher, attended the LSVT BIG® Training and Certification Course for treatment of individuals with movement disorders related to PD and was certified by LSVT Global, Inc. to provide treatment for individuals with movement disorders related to PD and other neurological disorders using the LSVT BIG® modalities.

Understanding how different types of large amplitude movements aid in facilitating functional mobility, it was important to become certified in LSVT BIG and this specific neurological population. The LSVT BIG program is an online training and certification course. Upon completion, the doctoral capstone student gained skills in this evidence-based, intensive treatment protocol for individuals living with PD and other neurological conditions. In this course she discovered the foundation of LSVT BIG and its key treatment principles/rationale along with an overview of efficacy data on LSVT BIG; learned details of the protocol and how to administer it to people who have varied abilities and functional goals; practiced all elements of the LSVT BIG protocol through video led demonstrations; unlocked the keys to making lasting changes in function through calibration training; acquired tips for assessment and

documentation; developed a lifelong model of care; learned to work together as an interdisciplinary team; and received helpful information on implementation to help offer LSVT BIG to people who would benefit from it (LSVT Global, 2022).

The knowledge and practice from the course helped the interactions with the participant involved in this program. From this knowledge she was better able to support, encourage, and advocate for this type of programming (LSVT BIG) for her participant of her aquatic exercise study when they feel they are confident and capable to complete the exercises out of the water. Additionally, the doctoral student had some education on PWR! from her previous Level IIB fieldwork and received some training at Re+Active during her capstone experience by two OT practitioners who are certified in PWR!. It was important to the doctoral student researcher to become educated on these heavily researched programs to understand the protocols these programs had created, and the reliability and validity behind them.

Program Procedure

After eligibility was confirmed and intake interview was completed, informed consent was then taken verbally over the phone with time to answer questions privately. The doctoral student researcher confirmed dates, time, and address with the participant to start the program on February 14, 2023. During the first session, the participant used an anonymous Qualtrics link to complete the PDQ-39 and completed the TUG test for pre-measures prior to entering the pool. Both assessments took the participant about 15-20 minutes to complete. Pre assessments were completed in a private setting with site provided tablets to complete the PDQ-39 and TUG test. Oxygen, heart rate, and blood pressure was taken before each session and during if there was any concern regarding the physiological response from the exercises of the participant.

The participant completed the four-week program, two times per week from February through March of 2023 in the pool that Hands on Rehab and Aquatics rents out at their Huntington Beach pool location, Waterworks Aquatics, 14401 Willow Ln, Huntington Beach, CA, 92647. With the anticipation of five participants, randomized numbers (1-5) would have been used to replace the participant's name to protect privacy. With only one participant, only one number was used (participant #1). If there was more than one participant, it was anticipated that there would have been different start times for their individual program, and there would have been a 15-minute grace period between each session to avoid participant interaction. All information gathered in this study was kept confidential. No reference was made in written or oral materials that could link them to this study. All records were stored in an encrypted password protected computer on the campus of UNLV and in the PI locked office, the data would be destroyed after three-years (2026).

The participant was aware that there may or may not be direct benefits to them as a participant in this study. The hope of this study was to learn how this intervention helps frame the need for an aquatic-based program to assist people with PD to increase functional mobility in their daily lives. From the literature of previous systematic reviews suggested that aquatic exercise was safe and beneficial for people with PD. It improves aspects of activity performance, quality of life, and balance. Aquatic therapy may be beneficial and safe for people diagnosed with PD to incorporate into their lives to help increase or maintain their occupational performance in their daily life. More research in the field of OT is needed on aquatic therapy and PD, coming from a holistic, client-centered view to help increase quality of life. Bringing more awareness to this field will help guide more research with PD, as well as other interventions for people. Creating a positive impact in the community will take diligence, time, and effort in

building relationships with clients, providers, and therapy centers. As the treatment of aquatic therapy is in its infancy, the goal of advancing its importance within the therapeutic community will be what also sustains it.

At the last session of the program, the participant received another Qualtrics link for the post test of the PDQ-39 and then completed the TUG test prior to entering the pool. Lastly, the doctoral student researcher asked the participant if she enjoyed this type of exercise in the pool setting. The participant received an incentive of $50 upon completion of the program which was prorated at $6.25 per visit.

Data Analysis

The standard deviation was compared to the mean of the scores to see whether there was an indication of an improvement trend. For the sample, it was anticipated that up to five participants would be evaluated to account for variations in age, gender, and illness severity (between stage I and II). Unfortunately, some of these participants did not meet the criteria and only one participant was able to complete the program.

Quantitative data to describe the sample was collected via a standardized demographic case report form (age, sex, race, ethnicity, marital status, education level and other conditions) during the initial criteria determination interview. During the duration of the program, current mediations were reported and recorded in an electronic system to keep track of any changes throughout the four weeks. See appendix A for recruitment flyer handed out to patients, appendix B for details of the informed consent form, and appendix E for a detailed outline of the 14-week capstone experience.

Adverse Events

For safety measures, if there were any adverse events prior to entering the water, the session would be voided. For example, any heart rate or blood pressure above acceptable range for activity this would have been considered an adverse event and the session would have been voided (see Definition of Events for Adverse Reports below from UNLV). The protocol was that the participant completed a 60-minute session of aquatic exercise and there was a check for normal physiological status prior to entering in the pool; check in with participant during 60-min exercise to ascertain if there were any signs or symptoms of physical distress; if there was physical distress, to pause session, get out of water or sit on stairs at entrance, and take a break until symptoms resolve or participant feels they can return. Each participant had to receive a letter of approval or verbal acceptance from a phone call from his or her physician before commencing the exercise program. People with PD should never go swimming alone; therefore, the doctoral student researcher and site mentor were always present. During the session, breaks were provided as needed. If any participant could not complete the program, data would have been used up to the point of discontinuing.

Program Protocol/Intervention

During the recruitment period, the student researcher completed her LSVT BIG certification to gain insight on how to complete large amplitude movements that benefit people with PD. Upon completion of certification, she developed and trialed large amplitude movements in the water on herself to see if these movements are feasible in three to five feet of water, then on other patients of Hands On Rehab and Aquatics at the Huntington Beach pool location with a variety of diagnoses (i.e. orthopedics, pain, and elderly). She created a warmup, eight exercise moves that go towards specific daily tasks/occupations, a cool down with stretching, and lastly

each sessions focus was to grade up on the movements if they were possible. The purpose was to complete these movement in mass repetition to aid in the plasticity of the brain and help the retrain the brain and the muscles to remember these movements. According to Stegemöller et al. (2009), there is evidence that the basal ganglia contribute more to continuous repetitive movements. When making overexaggerated repetitive movements, the muscles are retraining the brain to slow down the progression of hypokinesia (Stegemöller et al., 2009). See Appendix H and I for full description of program and explanation of how the movements go towards occupations.

During the start of the capstone experience, the doctoral student researcher observed OT and PT at Hands on Rehab and Aquatics clinic and Huntington Beach pool to gain an understanding of the company, the patients they saw, and how to best implement the program. She then was able shadow and assist at a neuro-specialized outpatient clinic, Re-Active in Torrance, CA, to gain more understanding of the PD population and insight from the therapists there. She received feedback on her proposed program she had created and was able to make adjustments where necessary on the program. The program was then finalized and trialed on therapists and a patient of Hands on Rehab, who wanted to test out the movements in the water, no diagnosis specific, to see if these movements were feasible to someone who does not have PD, but someone who has balance deficits. Once the program was finalized after making the final adjustments, the four-week program began.

Once the four-week program started, the first was about 90-minutes to go over any questions regarding the program, completion of the TUG test as a pre-measure, filled out Qualtrics link for the PDQ-39 pre-measures, and demonstration of the movements. During each session the doctoral student researcher demonstrated the movements for the participant to see

and then complete. The sessions were 60- minutes long in the pool. Each sequence of the large amplitude program had a total of eight upper/lower extremity movements such as marching, reaching, walking, twisting, and overhead movements. The participant came to each session changed and ready to get in the pool when signing into each session; prior to each session the student researcher checked heart rate, blood pressure, and oxygen prior to ensure appropriate phycological status then escorted them to the water. The last session of the program was 90-minutes to complete the post-measures and exit interview to document the patient subjective report. The total time of the program was eight sessions with two 90-minute sessions (first and last); six-sessions of two times per week at 60-minute sessions with a total of 570-minutes.

After the four-week program was completed, the doctoral student researcher was able to shadow neuro-specialized OT practitioners at Stanford Healthcare in Palo Alto, CA, to understand the process of when the population of PD are admitted to the hospital, reasons for admission, plans for discharge, and recommendations for neuro-outpatient programs. The doctoral student researcher educated the practitioners at Stanford on her program and the future opportunities for this population in this geographical area. After data collection, the doctoral student researcher disseminated outcome to the site mentor.

SECTION IV

ETHICAL AND LEGAL CONSIDERATIONS

Pool Safety Protocol

It was crucial to have ethical and legal considerations as PD is a vulnerable population, so heavy consideration was taken into account when developing this program. The current protocol used for aquatic therapy in the treatment of upper extremity injuries was derived from a previous study titled 'Aquatic Therapy in the Treatment of Upper Extremity Injuries,' authored by H. Binkley and T. Schroyer, which was published in Aquatic Therapy Today in 2002 and cited on page 50. See appendix F for details of pool safety protocol that were followed by the doctoral student researcher and clinical site mentor.

Overall, it was important to be mindful of pool safety to ensure the client was comfortable, able to report current or changes in their physiological status, if they were to experience a “freezing” episode, and/or reporting the feeling of any PD like symptoms such as lack of balance, rigidity, and tremors before entering the water. To reduce these risks, all exercise was in three to five feet of water, pool rails and Americans with Disabilities Act (ADA) requirements were available such as a Hoyer lift in and out of the pool, it was also possible for the clients to wear water shoes to reduce fall risk and irritation from pool floor. The doctoral student researcher and site mentor were always available during session, and pool flotation vests were available to those interested. Rest breaks were provided when needed.

When to Use Aquatic Therapy

Any participant who have contagious infections, exposed wounds, fever, chronic ear infections, excessive fear of water, seizure disorders, digestive system problems, recent or ongoing radiotherapy, severe burns, and illnesses that markedly affect the regulation of body

temperature are not qualified to partake in this program. See appendix G to see list of indications and contraindications.

Definitions of Events

The UNLV must perform periodic evaluations of research to satisfy the guidelines of the U.S. Office of Human Research Protections (OHRP), the Food and Drug Administration (FDA), and the UNLV Human Subject Policy (University of Nevada, Las Vegas, 2022). Part of this continuing review obligation is to monitor unforeseen events and negative responses (21 CFR 56.108 and 45 CFR 46.103) (University of Nevada, Las Vegas, 2022). The definition of events will continuously reflect on pool safety protocol from appendix F and indications/contraindications of aquatic therapy in appendix G.

Adverse Event Definitions

Unexpected Adverse Event is an adverse event that does not match the details in the approved protocol, risk information in the consent form, or the anticipated course of the underlying disease or condition being investigated (University of Nevada, Las Vegas, 2022).

Serious Adverse Event is an adverse event that may lead to death, hospitalization, persistent disability or incapacity, birth defects, cancer, overdose, or any medical condition requiring treatment to prevent any of the aforementioned outcomes, is considered a serious adverse event (University of Nevada, Las Vegas, 2022).

Related Adverse Event is an adverse event is considered related to the study drug, device, or intervention if there is a reasonable likelihood (e.g., a strong temporal association) that the adverse event was caused by the drug, device, or intervention (University of Nevada, Las Vegas, 2022).

Possibly Related Adverse Event is an adverse event that could be attributed to the drug, device, or intervention, but there is not enough data to ascertain the probability of such an association (University of Nevada, Las Vegas, 2022).

Unrelated Adverse Event is an adverse event that has apparently no relationship to the study. See appendix E for Adverse Event documentation (University of Nevada, Las Vegas, 2022).

SECTION V

RESULTS

Of the five possible participants, one was recruited into the intervention program (N=1) and completed a majority of the aquatic therapy program (missing one day, details in limitations section). See Table 1 for characteristics of the participant and standard normative data is represented for the participants age group in vitals to compare. See Table 2 for results of the before and after the four-week program as described by the mean (M) and standard deviation (SD), and the percent change value between pre and post measures. The program ran for four weeks, two-times per week for 60-90 minutes per session. Statistical analysis was used to determine these results, and the results demonstrate that aquatics is a safe and feasible intervention for people with PD and will be possible with people who have a secondary diagnosis of a lower extremity orthopedic deficit.

Remarkable clinical improvements were observed in both assessments of the TUG test and PDQ-39. The statistical analysis revealed a significant improvement in TUG scores, with a decrease of 32% (from 17.51 seconds to 11.92 seconds), indicating the participant went from a fall risk to no fall risk after four weeks of intervention. The PDQ-39 also showed a substantial clinical improvement of 34.1% with total score of $p = 0.058$, suggesting positive changes in PD symptoms. The lower the score of the PDQ-39 reflects better quality of life; the participant went from a total score of 44 points to 29 points after the four-week program.

The purpose of this research was to provide other opportunities for people with PD to complete exercise and rehabilitation/maintenance throughout their prognosis in a safe environment, like a pool. The hope is for this program to continue research with a larger sample of individuals with PD in the water performing large amplitude movements. Along with how to

continue to improve functional mobility and occupational performance outside of the water from the increased postural control while working in the water.

Case Study of Participant #1

Participant #1 was a 68-year-old Hispanic female with early stages (stage 1.5) of PD. She was diagnosed in 2018 and has been receiving OT services, strictly for fine motor coordination in her hands, until the start of the aquatic study at University of California, Irvine (UCI) Health in Irvine, CA. She has received PT services prior due to a left knee total arthroplasty. From the initial phone call for the informed consent and meeting the study's criteria, she reported that she had balance deficits and recently started using L-dopa patches about eight to nine months ago and has seen an increase in function due to the L-dopa. She is married and received strong support system consisting of her family and friends. Her primary care doctor, neurologist, and OT practitioner were able to clear her for completing the aquatic program and were ecstatic that she had the opportunity to be in this study. She reported she typically has a higher blood pressure (see Table 2 for details), but it is within normal ranges, and is managed per her primary care doctor. The participant had type 2 diabetes and would check blood sugar before and after sessions. This was not recorded; however, if an adverse event happened, the participant would check her blood sugar to see if it dopped and engage in the proper measures to increase it (i.e., eat a piece of candy). The participant was able to manage her diabetes well and was able to educate on her needs in case of emergency.

Below are the tables and figures representing participant #1 results of the assessments. To note, during the pre-test, before the start of the program, the participant used a cane as an assistive device during the assessment, had a slow tentative pace, no arm swing, slight shuffling, en bloc turning. During the post-test, after the four-week program, the participant did not need

the cane to complete the assessment and had little arm swing. Change Value was calculated to find difference since there was only one subject, unable to calculate paired t-test (one-tail and two-tail) for the individual variables. See Appendix L for participants physiological status (vitals).

Table 1

Characteristics of Participant

Number of Participant	N=1
Gender	Female
Age	68
Physiological Status (M)	BP: 147/80 mm Hg
	Resting HR: 77
	O2: 98
Standard Normative (Women 60+)	BP: 139/68 mm Hg
	HR: 75-78
	O2: 95-100
Parkinson's Disease Stage	1.5 (between stage I and II)
Ethnicity	Hispanic
Inclusion Criteria	18 years or older; English speaking; doctors note/doctor call; PD stages 1.5; willing to receive therapy in a pool; and normal physiological status.

Note. Participant was identified as an underrepresented population and specifically for PD.

Table 2

Results, before and after aquatic therapy program

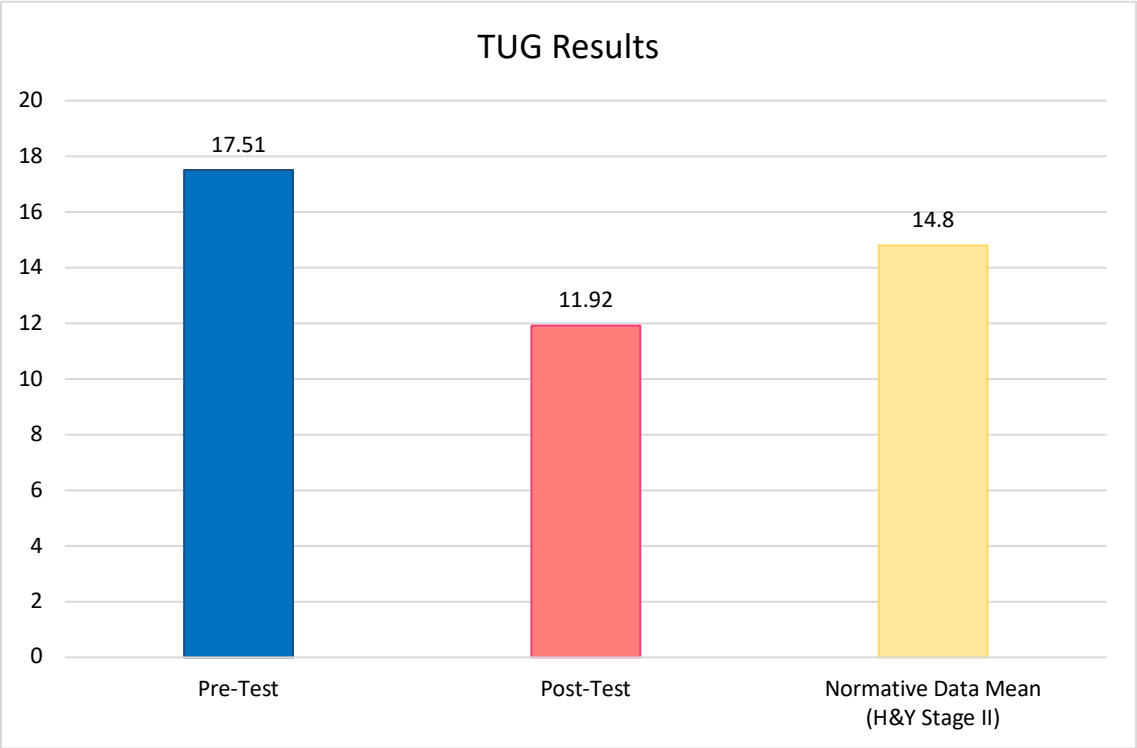
TUG (N=1)	*TIME*	*M*	*SD*	*MDC*
Pre-Test	17.51 seconds	15.4	2.984	5.59
Post Test	11.92 seconds			

PDQ-39 (N=1)	*Variables*	*Pre-Test*	*Post-Test*	*M*	*SD*	*Change Value*
	Total Scores	44	29	4.563	8.454	34% decrease
	Mobility	30	21	25.5	6.364	30% decrease
	Activity of Daily Living	3	1	2	1.414	66.7% decrease
	Emotional Well-Being	5	4	4.5	0.707	20% decrease
	Stigma	0	0	0	0	-
	Social Support	1	0	0.5	0.707	100% decrease
	Cognition	2	1	1.5	0.707	50% decrease
	Communication	1	1	1	0	0% increase
	Bodily Discomforts	2	1	1.5	0.707	50% decrease

Note. M = Mean; SD = Standard Deviation; MDC = Minimal Detectable Change. This table demonstrates the results of the TUG assessment and PDQ-39. Change value is a description that indicates the significance or magnitude of a change or difference seen between variables or conditions in a study, supporting research by determining the significance and practicality of the results.

Figure 1

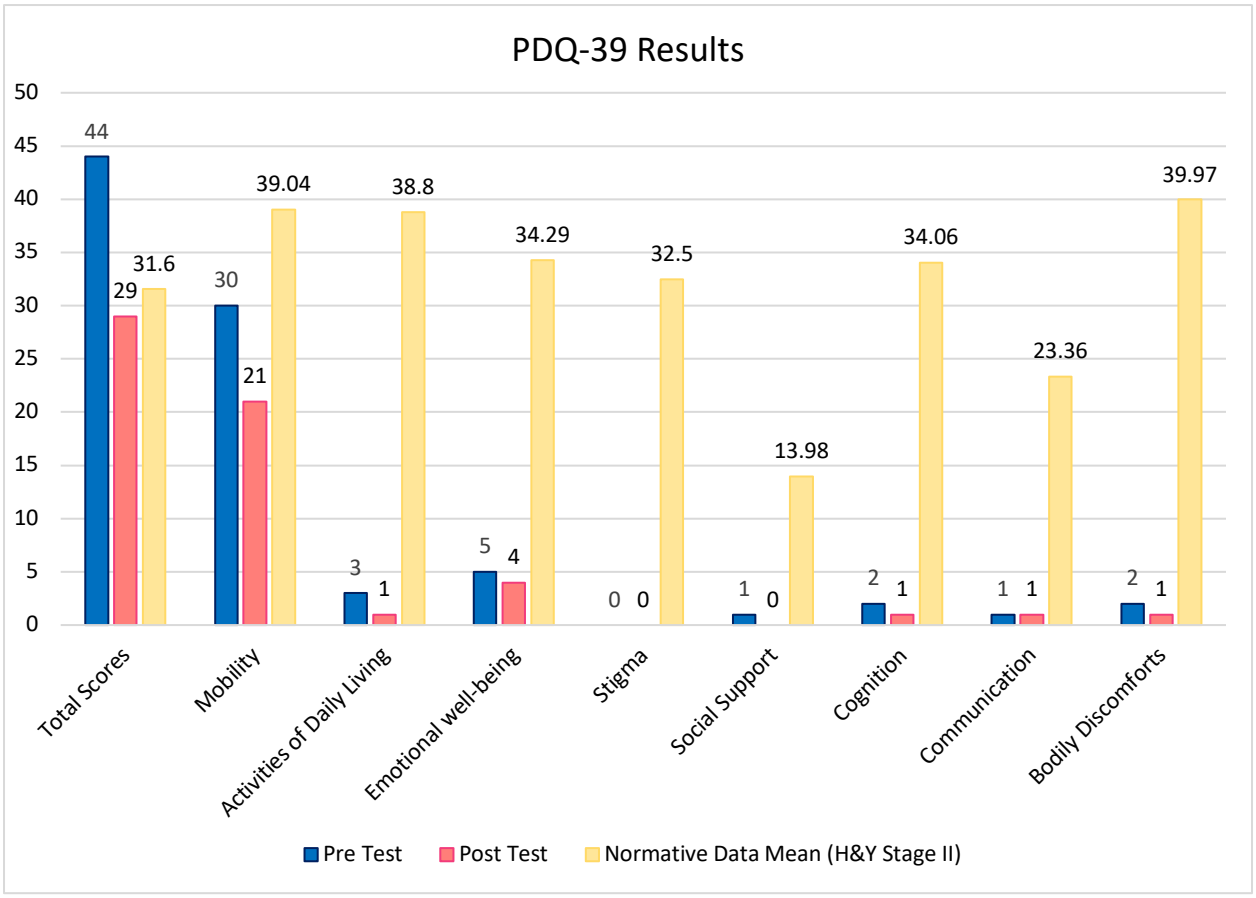
TUG Results



Note. The change went from 17.51 seconds prior to the four-week program to 11.92 seconds after the four-week program. The normative data for H&Y stage II was 14.8 seconds. This demonstrates the participant had benefitted from this program in terms of functional mobility. This moved her from a fall risk to no fall risk according to the TUG indications.

Figure 2

PDQ-39 Results



Note. Pre-test was prior to the four-week program, post-test was after the four-week program. The normative data of H&Y Stage II indicates the average scores of people in this stage of PD. The participant had lower perceived scores than the average, however, scores were able to decrease more after the four-week program.

The data was analyzed using Excel and verified by using SPSS software to confirm the results. The comparison included manual method, calculating on Excel, and then confirmation with SPSS. The mean (average) and standard deviation were compared to understand the results, which demonstrated an increase in functional mobility. The paired t-test was analyzed for the PDQ-39 with the overall score from the eight variables; however, the individual scores from the PDQ-39 of the eight variables had to be calculated using a change value. The overall scores had a P(T<=t) one-tail (0.058), and P(T<=t) two-tail (0.115). This was run to find out the significance of total scores. Since there was only one participant, understanding the data (N=1), the sum of the individual numbers of the eight variables are not valid with PDQ-39. According to Hagell and Nilsson (2009), when total scores are not unidimensional, they are essentially invalid and have unclear meanings since it is not apparent what the scores indicate; however, all 39 items together might still represent a single variable even if the eight variables. From this information, this demonstrated that individual attempts of the eight variables could not be calculated, but the total score was to find the p-values. The overall score of the 39 questions were calculated for the PDQ-39 and the change value of each variable (mobility, ADL, emotional well-being, stigma, social support, cognition, communication, and bodily discomforts) to reveal that her quality of life improved, as her scores decreased.

SECTION VI

DISCUSSION

The observational experiences and weekly impact on the participant helped determine the feasibility of this program. Detailed below consists of results pertaining to the data, as well as impact on the program. See Appendix H for program details. See appendix M for additional details on observational experience for clinical expertise on the development of this program, participant performance based on observation, participant self-report, clinical judgment of the doctoral capstone student and site mentor.

Program Discussion

The program hypothesized that due to gravity being reduced by participants being in the water, the buoyancy of water, which is about 50-60% of a person's body weight (Roland, 2019), that this program would make it easier for people with PD to move around and exercise. From the results, for this participant, this hypothesized to be accurate. According to Teasdale et al. (2016), proprioception dysfunction is common in people with PD, and may be brought on by decreased central sensory integration because of dopamine depletion in the basal ganglia. It has been demonstrated that basal ganglia neurons contain proprioceptive fields, and these neurons respond in a joint-specific manner (Teasdale et al., 2016). With this information, the water could potentially be an issue with some people with PD. Being in the water might feel counterintuitive because of having a proprioceptive disorder, due to possibly having limited motor control; however, the water does provide input with the vestibular, tactile, and proprioceptive systems (Bundy & Lane, 2020). Water stimulates the tactile system throughout the full surface of the body, and the input varies continually as both the water, and the person moves different body parts to break the surface (Bundy & Lane, 2020). The vestibular system gets improved by

moving in both the vertical and horizontal planes of the vestibular system and allows for more variation of position and movement than is available on land (Bundy & Lane, 2020). Proprioception is also improved by being able to move freely in water without the same pull of gravity while movement is amplified by the resistance from the water (Bundy & Lane, 2020). From the results, this program demonstrated that this may be beneficial in breaking through and challenging a person's motor control within the water. Herold et al. (2016) found that swimming integrates the senses therapeutically by providing tactile and kinesthetic cues to the CNS, which is important for helping the proprioception input from the water.

By changing the environment, such as land versus aquatic environment, this program provides people with PD new possibilities for stimulation of different parts of their sensory systems. Due to this, an increase functional mobility and occupational performance outside of the water is possible according to the data analysis of this case study. The hypothesis of this program deemed to demonstrate that this program can be helpful; however, completing a program in four weeks over eight sessions might not be enough time to see a wide range of statistical significance in the data. From this program, with Participant #1, there was an upward trend in functional mobility, quality of life, and occupational performance. This evidence of data is usable scholarship and contributes to the profession of OT and will impact research projects in the future with PD and aquatics. Additionally, according to Schumacher-Schuh et al. (2022), approximately 20 highly penetrant uncommon variations in genes are now linked to familial or monogenic types of PD, primarily in people of European ancestry. To have a participant not a part of European ancestry was important representation to other ethnicities.

From the results, it was shown that the participant benefitted from this program. With the TUG, her post-test scores showed a dramatic decrease. Her first trial she wanted to use the cane

due to fatigue; however, it was noted that the cane was negatively impacting her mobility and was asked if she felt comfortable to do a second trial without the cane. With the second trial, she did better than with the cane. This second trial was reported because from a clinical perspective and clinical judgement from doctoral capstone student and site mentor that she did not need the cane and showed improvement. She did not need the cane, but she felt she did, and that belief system, her internal versus external mastery, impacted her score, and her score was better without the cane. This implied that this program was effective for this one participant in Southern California. It would be helpful to fully understand this change with a larger sample size to see if this was a trend or an anomaly.

Based on her results on the PDQ-39, the intervention demonstrated highly effective with improvements specifically in mobility, where this program was created to focus on postural control and functional mobility. There was a clear trend towards improvement for this specific participant in mobility and it is supported from evidence from Osborne et al. (2021), that improved mobility decreases severity of PD symptoms and improves overall quality of life for individuals, and delays advancing of symptoms. This suggests that exercise is a great intervention and can delay symptom and severity in PD (Osborne et al., 2021). According to research, aerobic exercise slows down the course of motor symptoms in people with PD and improves cognitive function through promoting structural and functional plasticity in the corticostriatal sensorimotor and cognitive control networks (Johansson et al., 2022). This program implies that exercise in this environment may delay symptoms of PD. The impact of exercise and mobility is huge with PD and this program may help bridge a gap for people who are needing to remove gravity or decrease fear of falling by receiving exercise in the water.

Possible Recommendations

Future research could investigate private insurance to see how patients' coverage differs depending on the type of plan they have. This type of analysis could also examine differences in usage based on age, disability, employment status, and other factors. Understanding how billing works with different insurances is deemed to be important when creating a new program such as an aquatic therapy program for people with PD, and how insurance will or will not cover these types of services.

Future research could investigate individual versus group settings. This would provide less focus on biomechanics of the movements and provide more interaction with people who have similar background/diagnosis to give them a sense of community during this prognosis and study. Future research would be beneficial to see if there can be more changes if adding a home exercise program when not in pool session days to help increase strength, postural control, and enhancing quality of life. Possible home exercise programs could be tailored to safe exercises to complete seated or standing in conjunction with similar movements provided in the water, along with their individualized functional task goal to practice out of the water safely. Adding in the opportunity to incorporate dual tasking to increase cognitive ability while performing exercise in the water and to add more individualized functional tasks to increase independence outside of therapy. Learning what the client might need from the initial physical evaluation of their deficits and seeing their occupational performance in tasks can impact the future sessions. Performing a thorough occupational profile to see what else this program can offer them, then providing the aquatic exercises to increase their daily tasks could lead to more benefits.

Other future studies may include increasing the Hoehn and Yahr up to stage IV, if there is no cognitive decline. According to the Hoehn and Yahr stage IV is severe disability but ability to

walk or stand unassisted (Goetz, 2008). From education with LSVT GLOBAL on Hoehn and Yahr, it is possible to continue to provide services to people who have balance deficits, rigidity, and slowed gait, as long as the person is willing to participate. Increasing the stages could show outcomes to provide OT and aquatic services to many people with PD, rather than a smaller subgroup of individuals with only stages I-II. Overall, more research is needed in this field and there are many opportunities to advance and grow upon this program.

Project Evaluation

The initial evaluation method used was through impact evaluation to determine if this program had met its intended objectives and outcomes. The second evaluation method through implementation evaluation was to understand the pre-and post-measures of the quantitative and qualitative assessments used to see if this program contributed to success for functional mobility and quality of life. From the results, this program was beneficial to the participant, the goal would be how to sustain this program for the participant and other people who are able to receive this type of program. Moving this program forward in the future, working with a specific clinic, company, or hospital to help people receive this program, and be able to sustain it by educating more practitioners on implementing this program around the country where there is access to pools.

SECTION VII

LIMITATIONS

Since this project was created and implemented at one site in California, there are a few limitations that will be discussed. Limitations of this study included receiving only one participant rather than up to five to determine feasibility. This was due to time constraints; lack of transportation; living in a different location; dependability; lack of diversity and individuality of representation of the condition (i.e., gender, age, disease severity, ethnicity, location, geographical region); and lastly there was four potential participants with PD but did not meet eligibility of criteria (level of severity with stages, cognitive ability to safely be in water). The hope was during the recruitment process to have a variety of people applying to be a part of this study to avoid sample bias, and people who were going to follow through from beginning to end of the program; however, this was not reached.

It is possible that this study was significant due to being in a western geographical location, where the sun is out all year, there are more people who are willing to get into the pool, and there are more opportunities to receive aquatic therapy. Since Huntington Beach is a beach city, there may be more opportunities to swim and be in water than other geographical regions and this can have a factor in the results compared to completing this research in another state.

Other limitations include the absence of a true non-treatment control group, due to time restraints and small sample size, lack of long-term follow-up, and short duration of the program to see statically significant results in a variety of participants. A possible limitation could have been, if there was a larger sample group, the times of the week could have limited participants due to the program being set for Tuesday and Thursdays due to site mentor availability. Along with how many weeks it would take to improve functional mobility and performance to be

demonstrating improvements in ADLs, as it is known that it takes about four weeks to create muscle changes. If this program was more frequent or longer, there would be more opportunity to explore other outcome measures in addition to determining whether this could have a greater impact on ADL performance and postural control. Some limitations that influenced the methodological quality of this study, such as the fact that the participation of people with PD in aquatic interventions was not possible due to unavailability of the pool. In addition, the study had a low statistical power because of the reduced sample size (N = 1). Other studies also indicated difficulties in recruiting and engaging people with PD in studies due to time restrictions, level of disability, and transportation (Carroll et al., 2017; Farley & Koshland, 2005; Masiero et al., 2018).

Limitations with Participant #1 being three weeks before the start of the program she fell out of bed due to a vivid dream/hallucination during her sleep and hit her knee on the ground. According to her orthopedic doctor, she was able to still complete the program after confirming the exercises; however, there was no power or force to be placed on her lower extremities, like running, jumping, and twisting of the knees. This limited certain movements and exercises planned in the water but was able to be graded down to make the movements easier or adjust to reduce the risk of straining her injured knee. The goal was to wear ankle weights during the exercises, to give resistance and build strength while in the water but hold down the legs to prevent buoyancy of the body during unnecessary movements and increasing postural support. Due to the knee injury, this was not able to happen and there may or may not be benefits of weights to the ankle. Lastly, the goal of functional task exercises was to complete stairs in the pool and due to the knee injury, this was not possible and removed for her sessions during the program. Due to the results increasing and showing improvement in her scores, the question

continues as to whether the program would have impacted her performance going up and down the stairs and therefore decreasing her TUG score even more.

One limitation that could have resulted in significant results was the stage the participant was at (stage 1.5). This could have been different if there were more participants between stages I and II, as well as increasing the range to stage IV. Since the participant did not have as many deficits as someone who has stage III or IV, this could have impacted the results given the decrease of severity symptoms in someone with stage I and II.

One limitation during the timeline of the program that can arise is missing a session. Specifically for participant #1, she had to miss a day of the program during week 3 due to a migraine. She called in reporting she needed to rest and that she would see us the following program session. Due to time constraints, pool access, and site mentor availability, this session was unable to be made up which can limit some of the results and validity of improvements in assessment scores of this four-week program. Implications such as this one is normal within an outpatient therapy setting. Patients may get sick, not feel well, or have other pertaining health/life circumstances that can limit their participation.

SECTION VIII

CONCLUSION

The need for this program was to show that by reducing gravity this would help the individual with PD move more freely. Additionally, this would lessen their fear of falling by increasing their balance and functional mobility in the water which would translate to better function on land. The results from this feasibility/case study demonstrate that this is possible; however, there needs to be larger studies to deem its validity. From the case study, the participant reported, and observed by the doctoral capstone student, an increase in these measures with a decrease in a fear of falling. This program hoped to benefit the individual and their functional mobility as well as provide contribution to scholarship of discovery through research and understanding of the emerging area of aquatic therapy in a large amplitude exercise program for people diagnosed with PD.

The primary outcome of this study was to determine if this program is feasible. Based on the results, this was demonstrated to be feasible. The secondary outcome was to explore the perspectives of a participant with PD who had participated in this aquatic therapy large-amplitude program based on if this intervention contributed to changes in posture, balance, and functional performance in order to develop meaningful assessments, outcomes, and future studies. The participant confirmed that this program increased their quality of life and functional mobility. Lastly, the doctoral student researcher wanted to make sure this program was enjoyable for the participant, in turn the results demonstrated this was enjoyable and increased her quality of life.

Overall, the hypothesis that a large-amplitude aquatic-based exercise program will help improve functional mobility and occupational performance in people diagnosed with PD was

supported given the pre and post results of the TUG and PDQ-39. Changing the environment and focusing on the framework of PEO-P and using the biomechanical frame of reference helped support the feasibility of this program for this participant in Southern California. The clinical implications of this study demonstrate that more research needs to be done in this setting. The hope for the future of OT research is to continue studies with larger sample sizes and continue to implement aquatic-based interventions, such as this one, to provide another means of therapeutic intervention to people with PD and continue to provide opportunities for meaningful engagement in occupations.

APPENDICES

Appendix A

Recruitment Flyer

Appendix B

Informed Consent

INFORMED CONSENT

Department of Brain Health – Occupational Therapy

TITLE OF STUDY: FEASIBILITY OF A LARGE-AMPLITUDE AQUATIC-BASED EXERCISE PROGRAM FOR INDIVIDUALS WITH EARLY PARKINSON'S DISEASE

INVESTIGATOR(S): DONNAMARIE KRAUSE, PHD, OTR/L; BRIGITTE BAKER OTD/S

For questions or concerns about the study, you may contact Donnamarie Krause or at **702-895-1844**

For questions regarding the rights of research subjects, any complaints or comments regarding the manner in which the study is being conducted, contact **the UNLV Office of Research Integrity – Human Subjects at 702-895-0020 or via email at IRB@unlv.edu.**

It is unknown as to the level of risk of transmission of COVID-19 if you decide to participate in this research study. The research activities will utilize accepted guidance standards for mitigating the risks of COVID-19 transmission: however, the chance of transmission cannot be eliminated.

PURPOSE OF THE STUDY

You are invited to participate in a research study. The purpose of this study is to determine if a 4-week (60-minute, 2- times per week for a total of 8 sessions) water-based, exercise program to increase balance for improved walking and participating in daily tasks for individuals with Parkinson's Disease stage I-II.

PARTICIPANTS

You are being asked to participate in the study because you fit this critera:

- 18 years or older
- Parkinson's Disease (Stage I-II)
- Willing to receive therapy in pool environment of 89-94 degrees
- Able to tolerate being in the pool
- Able to obtain physician's note to be in the pool and participate

You will not being able to participate if you:

- Do not have access to telephone and/or computer
- Cannot meaningfully participate and follow instructions
- Your physician indicates otherwise
- Have any diagnosis stopping you from safely participating in water exercise, such as the following, which may make you ineligible for the study:

Contagious infections, open wounds, fever, chronic ear infections, abnormal blood pressure, excessive fear of water, Epilepsy, gastrointestinal disorders, current or recent radiation therapy, sever burns, diseases grossly affecting body temperature.

PROCEDURES

If you volunteer to participate in this study, you will be asked to do the following: Attend 8 sessions at the Hands on Rehab and Aquatics facility. Membership or affiliation with the facility is not required to participate.

It is estimated up to 5 members will be recruited for the 4-week program, January, 2023 through March 2023. This program will be in a pool.

Balance will be measured by a Timed Up and Go Test. A survey called PDQ-39 will also be completed via site provided tablet using a Qulatrics link. This survey measures your happiness in life. If any question makes you nervous or anxious you can skip the question and move to the next.

Overall schedule of activities for you:

Each participant will receive a phone call to explain the program and determine appropriateness for the study. Informed consent will be done over the phone and take about 30-minutes. You will be identified on file by an assigned number (01, 02, 03).

Sessions will be individually with the Student Researcher and the first and last sessions will be 90 minutes. You will receive your signed Informed Consent. You will complete a survey using a Site provided tablet with a link to PDQ-39. You will then complete the Timed Up and Go Test. For this test you will stand up, walk 10 feet and return to sit. There will be time to answer any questions.

All movements to be done in the pool will be demonstrated by the Student Researcher. Each pattern of the large amplitude program will use 5- arm and leg movements such as marching, reaching, walking, twisting, overhead movements.

The remaining 6 sessions will be 60 minutes 2 times per week.

You will come to each session already in swimwear. Before entering the water, the Student Researcher will check heart rate, blood pressure, and oxygen using oximeter and blood pressure cuff. This is for safety before going in the water. Should you have heart rate or blood pressure above acceptable range for activity this will be considered an adverse event and your participation in the session will be ended.

Information will be entered using only your randomized assigned number.

The Student Researcher will be in the water showing each pattern of the large movement exercise program using about 5- arm and leg movements, such as marching, reaching, walking, twisting, overhead movements. You will then copy the movements in the water.

You will complete 6- 60-minute sessions of large movement water exercise. If physical sign of unwell the session will be paused for you and you will get out of water and take a break until symptoms

resolve or you feel better.

Total time: 8 sessions with 2-90-minute sessions first and last; 6-sessions of 2x/week at 60-minute sessions. 570-minutes total

Any participant that cannot complete the program, data will be used up to the point of discontinuing.

BENEFITS OF PARTICIPATION

There may be direct benefits to you as a participant in this study. We hope to learn if a large movement water-based exercise program helps people with Parkinson's Disease. We hope to learn if there is improved balance and ability in daily life activities.

RISKS OF PARTICIPATION

There are risks involved in all research studies. This study may include only minimal risks.

The risks of this study are minimal but questions or time commitment of (approximately 60-minutes) may cause anxiety. Strict protocol will be followed.

You cannot get into the water if you have any of the following, which may make you ineligible for the study:

Contagious infections
Open wounds
Fever
Chronic ear infections
Abnormal blood pressure
Excessive fear of water
Epilepsy
Gastrointestinal disorders
Current or recent radiation therapy
Severe burns
Diseases grossly affecting thermoregulation

To reduce risks:

- Water shoes should be used
- All exercise will be in 3' of water
- Pool rails and ADA requirements are available
- Student researcher is available at all times
- Pool Flotation vests are available to those interested
- Rest breaks will be provided

COST /COMPENSATION

There may be financial cost to you to participate in this study, such as transportation to the clinic (gas to arrive and back). The study will take 4 weeks about 1-hour, 1-2 times per week of your time. A

small incentive of $50 Target gift card is offered to those who complete all sessions. Or at a prorated amount based on participation.

CONFIDENTIALITY

All information gathered in this study will be kept confidential by allocating randomized numbers to each individual. No reference will be made in written or oral materials that could link you to this study. All records will be stored in an encrypted and password protected computer on the campus of UNLV and in a locked office until the completion of the study for 3-years after which the data will be destroyed.

VOLUNTARY PARTICIPATION

Your participation in this study is voluntary. You may refuse to participate in this study or in any part of this study. You may withdraw at any time without prejudice to your relations with UNLV. You are encouraged to ask questions about this study at the beginning or any time during the research study.

PARTICIPANT CONSENT:

I have read the above information and agree to participate in this study. I have been able to ask questions about the research study. I am at least 18 years of age. A copy of this form has been given to me.

Signature of Participant Date

Participant Name (Please Print)

Signature of Researcher Date

Appendix C

Assessments

TUG Assessment

TIMED UP AND GO (TUG) TEST

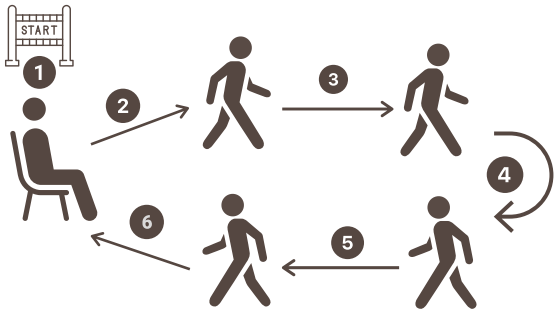
A WALKING TEST TO MEASURE
YOUR RISK OF FALLING

What's the purpose?

This test is used to assess the way you walk and balance. Research shows that the results are related to risk of falling.

How will I be tested?

A healthcare provider will watch and time how long it takes you to stand up, walk 10 feet, and walk back. They may ask you to do a practice round first. You can use a brace, cane, walker, or any device you use to walk.



1. Start by sitting in the chair.
2. Stand up and walk forward. Timer starts now!
3. Walk forward 10 feet.
4. Turn around when you reach the 10 foot mark.
5. Walk 10 feet back to chair.
6. Sit down in the same chair. Timer stops now!

What does my walking time mean?

In general, research shows that faster walking times on this test are related to lower risk of falling. However, your healthcare provider is also watching the way that you walk and balance.

Less than 20 seconds:
Lower risk of falling

More than 20 seconds:
Higher risk of falling

Have a conversation with your healthcare provider about what the results mean for you as an individual.

To see a full summary of this test and more, visit sralab.org/rehabilitation-measures
Questions? Contact us at rehabmeasures@sralab.org or 312-238-2802

Shirley Ryan AbilityLab
Center for Rehabilitation Outcomes Research

The contents of this infographic were developed under a grant from the National Institute on Disability, Independent Living, and Rehabilitation Research (NIDILRR grant number 90DPKT0007). NIDILRR is a Center within the Administration for Community Living (ACL), Department of Health and Human Services (HHS). The contents of this infographic do not necessarily represent the policy of NIDILRR, ACL, or HHS, and you should not assume endorsement by the Federal Government.

ASSESSMENT

Timed Up & Go (TUG)

Patient _____

Date _____

Time _____ ☐ AM ☐ PM

Purpose: To assess mobility

Equipment: A stopwatch

Directions: Patients wear their regular footwear and can use a walking aid, if needed. Begin by having the patient sit back in a standard arm chair and identify a line 3 meters, or 10 feet away, on the floor.

NOTE: Always stay by the patient for safety.

① Instruct the patient:

When I say "Go," I want you to:

1. Stand up from the chair.
2. Walk to the line on the floor at your normal pace.
3. Turn.
4. Walk back to the chair at your normal pace.
5. Sit down again.

② On the word "Go," begin timing.

③ Stop timing after patient sits back down.

④ Record time.

Time in Seconds: _____

An older adult who takes ≥12 seconds to complete the TUG is at risk for falling.

OBSERVATIONS

Observe the patient's postural stability, gait, stride length, and sway.

Check all that apply:

- ☐ Slow tentative pace
- ☐ Loss of balance
- ☐ Short strides
- ☐ Little or no arm swing
- ☐ Steadying self on walls
- ☐ Shuffling
- ☐ En bloc turning
- ☐ Not using assistive device properly

These changes may signify neurological problems that require further evaluation.

CDC's STEADI tools and resources can help you screen, assess, and intervene to reduce your patient's fall risk. For more information, visit www.cdc.gov/steadi

Centers for Disease Control and Prevention
National Center for Injury Prevention and Control

2017

STEADI Stopping Elderly Accidents, Deaths & Injuries

PDQ-39 QUESTIONNAIRE

Please complete the following

Please tick <u>one</u> box for each question

	Due to having Parkinson's disease, how often <u>during the last month</u> have you....	**Never**	**Occasionally**	**Sometimes**	**Often**	**Always** or cannot do at all
1	Had difficulty doing the leisure activities which you would like to do?	☐	☐	☐	☐	☐
2	Had difficulty looking after your home, e.g. DIY, housework, cooking?	☐	☐	☐	☐	☐
3	Had difficulty carrying bags of shopping?	☐	☐	☐	☐	☐
4	Had problems walking half a mile?	☐	☐	☐	☐	☐
5	Had problems walking 100 yards?	☐	☐	☐	☐	☐
6	Had problems getting around the house as easily as you would like?	☐	☐	☐	☐	☐
7	Had difficulty getting around in public?	☐	☐	☐	☐	☐
8	Needed someone else to accompany you when you went out?	☐	☐	☐	☐	☐
9	Felt frightened or worried about falling over in public?	☐	☐	☐	☐	☐
10	Been confined to the house more than you would like?	☐	☐	☐	☐	☐
11	Had difficulty washing yourself?	☐	☐	☐	☐	☐
12	Had difficulty dressing yourself?	☐	☐	☐	☐	☐
13	Had problems doing up your shoe laces?	☐	☐	☐	☐	☐

*Please check that you have ticked **one box for each question** before going on to the next page*

Due to having Parkinson's disease, how often <u>during the last month</u> have you....		***Please tick <u>one</u> box for each question***				
		Never	**Occasionally**	**Sometimes**	**Often**	**Always** or cannot do at all
14	Had problems writing clearly?	☐	☐	☐	☐	☐
15	Had difficulty cutting up your food?	☐	☐	☐	☐	☐
16	Had difficulty holding a drink without spilling it?	☐	☐	☐	☐	☐
17	Felt depressed?	☐	☐	☐	☐	☐
18	Felt isolated and lonely?	☐	☐	☐	☐	☐
19	Felt weepy or tearful?	☐	☐	☐	☐	☐
20	Felt angry or bitter?	☐	☐	☐	☐	☐
21	Felt anxious?	☐	☐	☐	☐	☐
22	Felt worried about your future?	☐	☐	☐	☐	☐
23	Felt you had to conceal your Parkinson's from people?	☐	☐	☐	☐	☐
24	Avoided situations which involve eating or drinking in public?	☐	☐	☐	☐	☐
25	Felt embarrassed in public due to having Parkinson's disease?	☐	☐	☐	☐	☐
26	Felt worried by other people's reaction to you?	☐	☐	☐	☐	☐
27	Had problems with your close personal relationships?	☐	☐	☐	☐	☐
28	Lacked support in the ways you need from your spouse or partner?	☐	☐	☐	☐	☐
	If you do not have a spouse or partner tick here		☐			
29	Lacked support in the ways you need from your family or close friends?	☐	☐	☐	☐	☐

*Please check that you have ticked **one box for each question** before going on to the next page*

Due to having Parkinson's disease, how often <u>during the last month</u> have you....		***Please tick <u>one</u> box for each question***				
		Never	**Occasionally**	**Sometimes**	**Often**	**Always**
30	Unexpectedly fallen asleep during the day?	☐	☐	☐	☐	☐
31	Had problems with your concentration, e.g. when reading or watching TV?	☐	☐	☐	☐	☐
32	Felt your memory was bad?	☐	☐	☐	☐	☐
33	Had distressing dreams or hallucinations?	☐	☐	☐	☐	☐
34	Had difficulty with your speech?	☐	☐	☐	☐	☐
35	Felt unable to communicate with people properly?	☐	☐	☐	☐	☐
36	Felt ignored by people?	☐	☐	☐	☐	☐
37	Had painful muscle cramps or spasms?	☐	☐	☐	☐	☐
38	Had aches and pains in your joints or body?	☐	☐	☐	☐	☐
39	Felt unpleasantly hot or cold?	☐	☐	☐	☐	☐

*Please check that you have ticked **one box for each question** before going on to the next page*

Thank you for completing the PDQ 39 questionnaire

Appendix D

Adverse Event

UNLV
UNIVERSITY OF NEVADA LAS VEGAS
Office of Research Integrity
Human Subjects

IRB Received Date Stamp—Office Use Only	IRB Protocol Number—Office Use Only

Adverse Event Report (AER)

An **adverse event** is any untoward occurrence in a research participant, which may or may not have a causal relationship with the study intervention/treatment.

Instructions:
1. All sections of this form must be completed.
2. Attach all relevant documents as described below and submit within the required timetable.
3. Submit this form via email to ORI-Human Subjects at IRB@unlv.edu.
4. Handwritten and hand delivered forms will not be accepted.

Request review by: ☐ Biomedical IRB ☐ Social/Behavioral IRB

1. Dates and Report Types:

a) Today's Date: 1/00/2010

b) Date of adverse event: 1/00/2010

c) Date that the adverse event was reported to OPRS: 1/00/2010

d) Type of report:

☐ Initial report ☐ Follow-up report

2. Research Project Title: _____

Research Project #: _____

3. Principal Investigator:

PI Name: _____

☐ Faculty ☐ Faculty Advisor ☐ Professional Staff

Contact phone #: _____ Email: _____

4. Adverse Event Information:

a) Adverse event summary (use 3-4 words): _____

b) Location of the adverse event:

☐ Internal Explain: _____
☐ External Explain: _____

c) The adverse event appears to be: ☐ Expected ☐ Unexpected

d) Based upon your review of the information, what is the relationship of the event of the research?

☐ Definite – clearly related to the research
☐ Probable – likely related to the research
☐ Possible – may be related to the research
☐ Unlikely – doubtfully related to the research
☐ Unrelated – clearly not related to the research

e) Research involved the use of a:
- ☐ Procedure (Including, but not limited to: surveys, treatment, etc.)
- ☐ Device
- ☐ Drug

f) In your opinion, do you expect this event to occur again? ☐ Yes ☐ No

g) Is the event adequately described in the Protocol and Consent Form? ☐ Yes ☐ No

h) Has the level of risk changed as a result of this event? ☐ Yes ☐ No

If yes, please answer the following:

The level of risk has: ☐ Increased ☐ Decreased

Should the protocol be modified to describe this change of risk? ☐ Yes ☐ No

Should the consent form be modified as a result of this change of risk? ☐ Yes ☐ No

If yes, you are required to submit a Modification Form and revised Protocol and/or Informed Consent.

Should participants be re-consented as a result of this change of risk? ☐ Yes ☐ No

Note: If the level of risk has increased, participants must be re-consented.

i) Detail the adverse event. In this description, please include the investigator's analysis of the event. Use additional pages as necessary. _____

j) Event outcome (check all that apply):
- ☐ Death
- ☐ Disability
- ☐ Congenital anomaly/birth defect
- ☐ Resolved
- ☐ Injury Explain: _____
- ☐ Life Threatening
- ☐ Hospitalization
- ☐ Required intervention to prevent permanent damage
- ☐ Discontinued from study

k) Enrollment Status

Is this project closed to accrual? ☐ No ☐ Yes

If yes, check the appropriate box below.
- ☐ Participants are still receiving study treatment/intervention/procedures.
- ☐ Participants have completed study treatment/intervention/procedures; continue in follow-up observation or long-term follow-up.
- ☐ Participant involvement completed but data analysis is continuing.

5. Investigator Endorsement

_____	_____	_____
Principal Investigator's Name	Principal Investigator's Signature	Date

For UNLV IRB Use Only

☐ No further action needs to be taken ☐ Request for further action (see comments below)

Comments: _____

IRB Chair/Co-Chair Signature	Date

Appendix E

Program Outline

Dates	Weekly Activity Description
Week 1 1/9/23-1/13/23	**Shadowing Clinic and Pool – Orientation** Monday – Thursday Intro to get rundown of Hands on Rehab and Aquatics, observe at pool with PTA, COTA, and OTR/L
Week 2 1/16/23-1/20/23	**Shadowing Clinic and Pool – Orientation and Finalizing** Monday/Tuesday/Thursday at pool hands on with clients and therapists Wednesday: Evaluation and Discharge of participant
Week 3 1/23/23-1/27/23	**Shadowing Re-Active OT – recruitment, interacting, evaluating** Monday-Thursday Re+Active Neuro Specialized Clinic Learn more about PD and interventions from PT and OT Hands on with clients and therapists
Week 4 1/30/23-2/3/23	**Shadowing Re-Active OT – recruitment, interacting, evaluating** Monday-Thursday Neuro Specialized Clinic Develop/Finalize Program Week Outline/Mentorship and Feedback on Program Hands on with clients and therapists, confirm outline program with 2 OTR/L specializing in PD
Week 5 2/6/23-2/10/23	**Site Clinic and Pool – continue recruitment, mentorship of site, refinement of program** Monday-Thursday Hands on with clients and therapists at pool Finalize Details, Observation in Pool, Trial steps of program with therapists and get feedback, trial with patients in pool (no Dx specific)

Week 6 2/13/23-2/17/23	**Program Starts** Monday: review and practice program Tuesday: PROGRAM, documentation Wednesday: research on more ways to improve verbal cueing, UCI Parkinson Wellness Program Thursday: PROGRAM, documentation
Week 7 2/20/23-2/24/23	**Program Implementation** Monday: review and practice program Tuesday: PROGRAM, documentation Wednesday: adjustments to program Thursday: PROGRAM, documentation
Week 8 2/27/23-3/3/23	**Program Implementation** Monday: review and practice program Tuesday: PROGRAM, documentation Wednesday: adjustments to program, research on standardized protocols Thursday: PROGRAM, documentation
Week 9 3/6/23-3/10/23	**Program End** Monday: review and practice program Tuesday: PROGRAM, documentation Wednesday: adjustments to program, research on other assessment tools for future Thursday: PROGRAM, documentation
Week 10 3/13/23-3/17/23	**Refinement for future programs, collaborate with professionals** Feedback on how to improve program Ongoing mentorship with collaboration from site mentor and other therapists Complete outcome measures Stanford Healthcare preparation
Week 11 3/20/23-3/24/23	**Stanford Healthcare – Neuro-outpatient clinic** Feedback on how to improve program

	Collaborate with therapists for future research Ongoing mentorship with collaboration from site mentor and other therapists Complete outcome measures
Week 12 3/27/23-3/31/23	**Data Analysis and Debriefing** Evaluating the data that has been collected Atlas.ti Excel sheet Qualtric XM
Week 13 4/3/23-4/7/23	**Data Analysis and Debriefing** Processing the data Atlas.ti Excel sheet Qualtric XM Write up and edits of discussion, limitations, and future studies Discussion with site mentor on paper and findings
Week 14 4/10/23-4/14/23	**Data Analysis and Debriefing** Analyzing the data and creating outcomes and conclusions Write up and edits of discussion, limitations, and future studies and present to Greg PT, DPT

Appendix F

Pool Safety Protocol

This protocol is adapted from “Aquatic Therapy in the Treatment of Upper Extremity Injuries,” by H. Binkley and T. Schroyer, 2002, *Aquatic Therapy Today, 7*(1), p. 50. Below will be the pool safety protocol being followed by doctoral student researcher and clinical site mentor.

I. Each person must receive a letter of approval from his or her physician before commencing an exercise program.

II. People with Parkinson's disease may never go swimming alone.

III. Balance issues and "freezing" can lead a person to lose their footing or tip forward or backward, leaving them unable to return to a standing posture.

IV. Swimming pool attire is vital for comfort and safety.

   a. Bathing suits need be comfortable.

   b. Suits that are too loose might fill with water and add weight.

      i. They also increase drag, which may interfere with workout performance and perhaps cause balance issues.

      ii. A suit that is overly tight might impede mobility and cause circulation problems.

      iii. Individuals can wear water shoes while entering the pool.

      iv. Shoes will give traction while also protecting the feet ' soles from scratches on the pool's floor.

V. For people who have major balance issues, shoes that look like standard training shoes but are particularly designed for water will give extra support.

VI. Other shoes resemble socks or slippers and, while not as supportive, will nonetheless give traction and protection to the feet's soles.

VII. For some persons with Parkinson's disease, getting into the pool may be difficult.

VIII. Pools with stairs may feature a rail so that individuals may walk into the pool with support.

IX. Dry ramps or movable flooring may be present in certain pools.

X. Some people may require the use of a chair lift to access and exit the pool.

XI. It is recommended that someone accompany the individual when entering and exiting the pool to prevent slips and falls.

XII. The shallow end of the pool is ideal for exercising, and the water may not be higher than chest level.

XIII. Individuals may keep an arm's length away from the pool's edge in various circumstances.

XIV. If "freezing" or loss of balance happens, the person can use the pool's side to assist re-establish alignment and safe mobility.

XV. Some people may find it more secure to conduct exercises while holding onto a noodle or foam hand bars.

XVI. Over-exercising may be avoided by those with Parkinson's disease.

a. This can result in weariness, limiting one's ability to work out safely and efficiently, as well as exiting the pool at the conclusion of class.

XVII. A person who is just starting a program may only be able to handle two or three 20-minute sessions each week.

a. Some people will progressively improve their tolerance for 45 minutes to an hour of water exercise.

XVIII. During the lesson, you may need to take a break.

XIX. A person can feel motivated after a class, not frustrated. This will encourage exercise compliance.

Appendix G

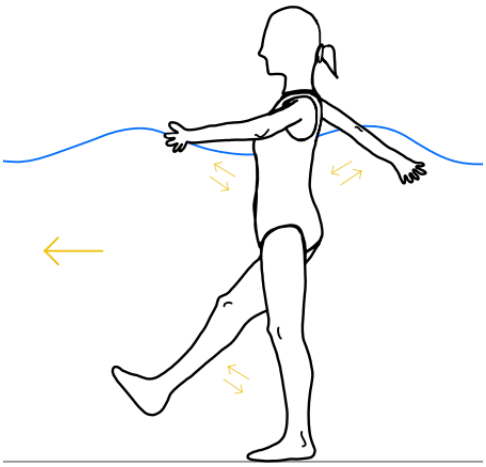
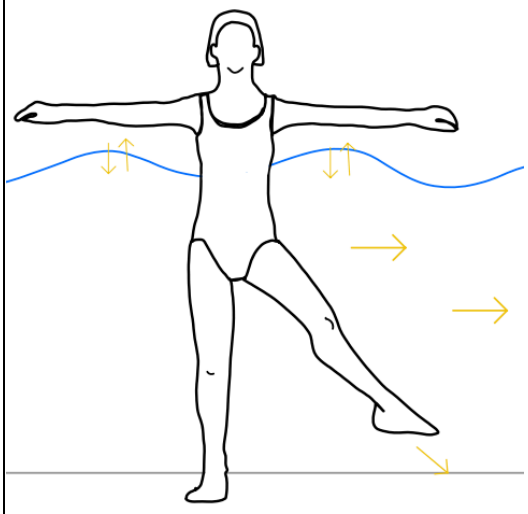
When to Use Aquatic Therapy

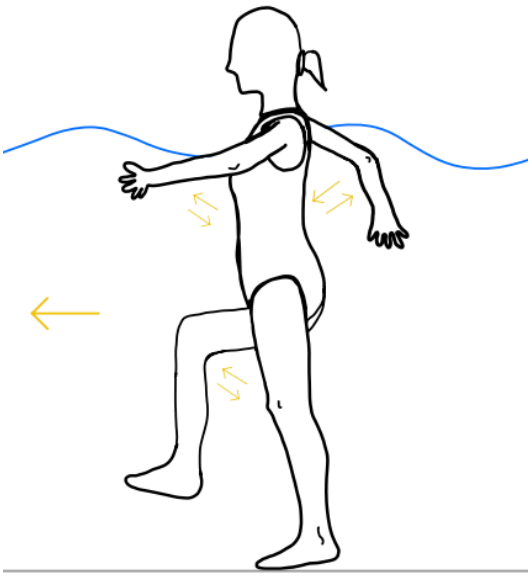
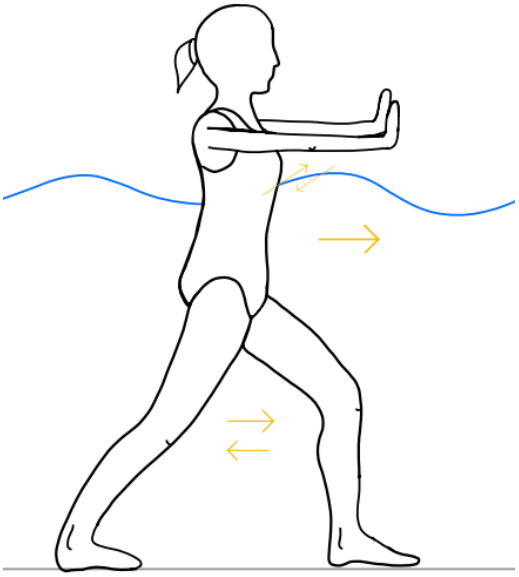
Indications	Contraindications
● High pain level ● Gait deviations ● Decreased mobility ● Weakness ● Poor coordination ● Limited weight bearing ● Poor muscle endurance ● Decreased cardiovascular endurance ● Joint contractures ● Decreased flexibility ● Poor proprioception ● Increased muscle tone ● Decreased range of motion ● Decreased balance ● Edema ● Poor facial control ● Respiratory problems	● Contagious infections ● Open wounds ● Fever ● Chronic ear infections ● Excessive fear of water ● Epilepsy ● Gastrointestinal disorders ● Current or recent radiation therapy ● Severe burns ● Diseases grossly affecting thermoregulation

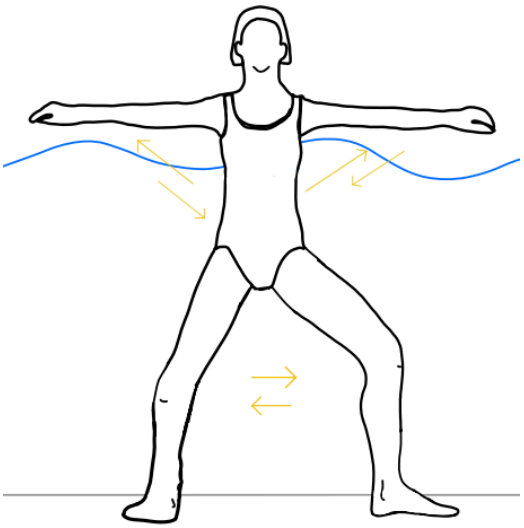
Note. Information adapted from "Aquatic Therapy in the Treatment of Upper Extremity Injuries," by H. Binkley and T. Schroyer, 2002, *Aquatic Therapy Today, 7*(1), p. 50.

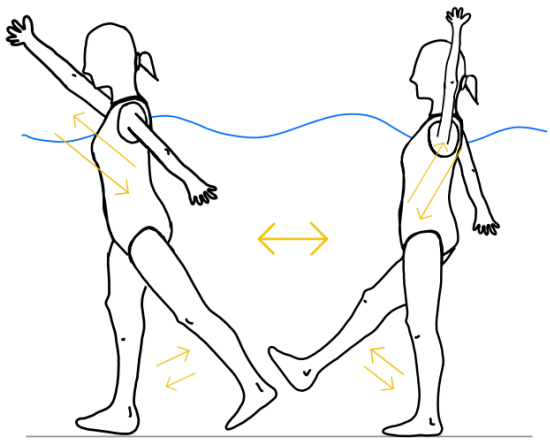
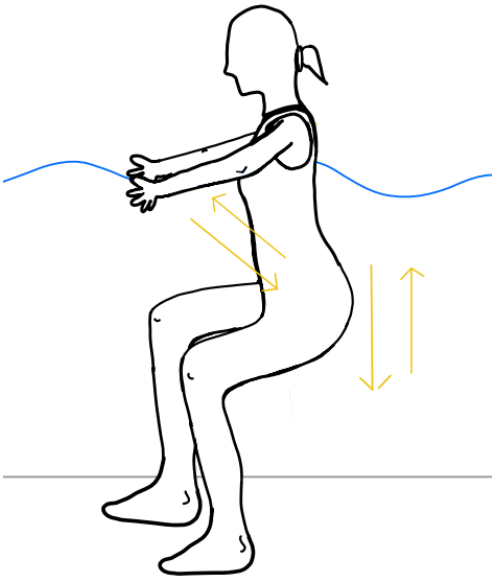
Appendix H

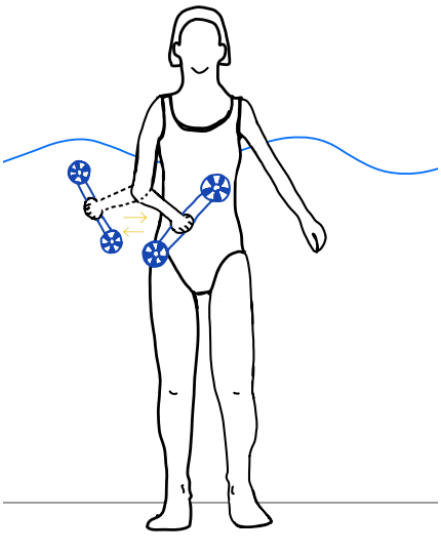
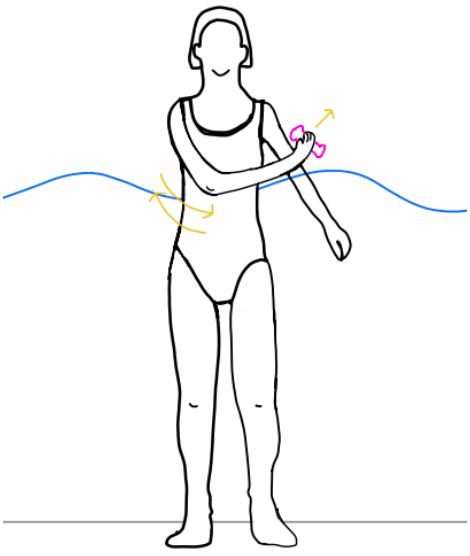
Aquatic-Based Large-Amplitude Exercise Program

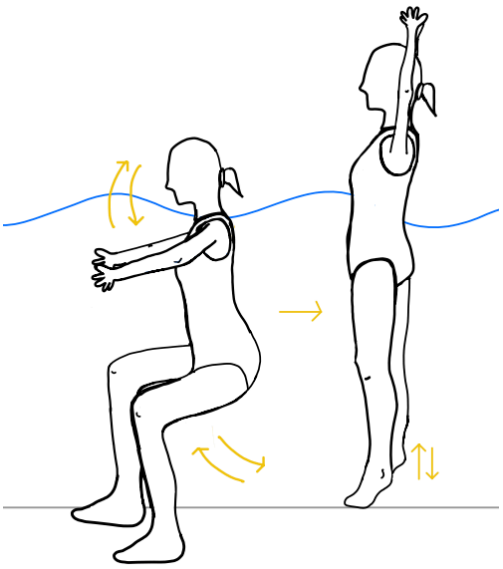
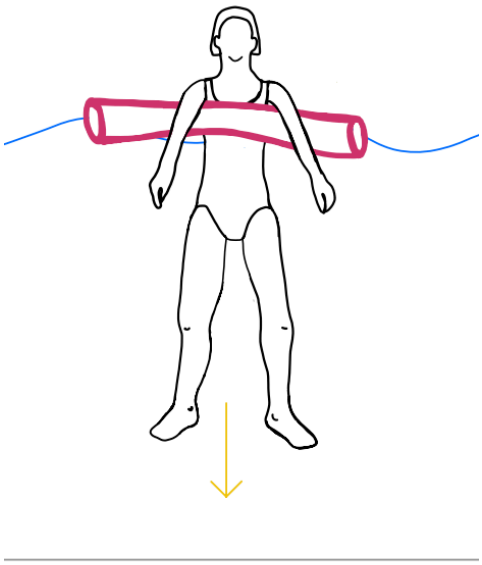
Day 1	Set and Repetitions	Grade up or down depending on level of ability	Picture and Notes
Warm Up – weights on ankles and arms (for postural stability)			
1. Forward/ Backward walking	2 laps		 Large steps forward (and if possible backwards) with large amplitude arm swing
2. Sidestep walking	2 laps		 Large steps sideways with large amplitude arm swing. Arms abduct up during step and adduct down when taking step in.

3. Marching	2 laps		 Bring flexed knee up high with large arm swing, step down and repeat with other leg.
Lower and Upper Extremity			
1. Lunge step forward and hold for 10 seconds	1-2 x 10		 Similar to the beginning of the marching step, then continue to step out and swing arms in large motion up to 90 degrees, hold for 10 seconds and swing arms down to side while stepping back. Focus on core control during step back

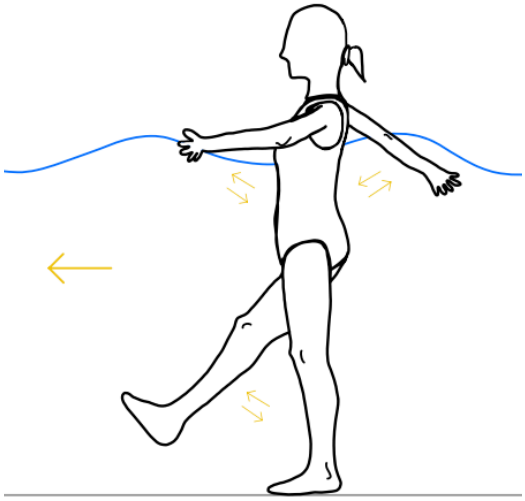
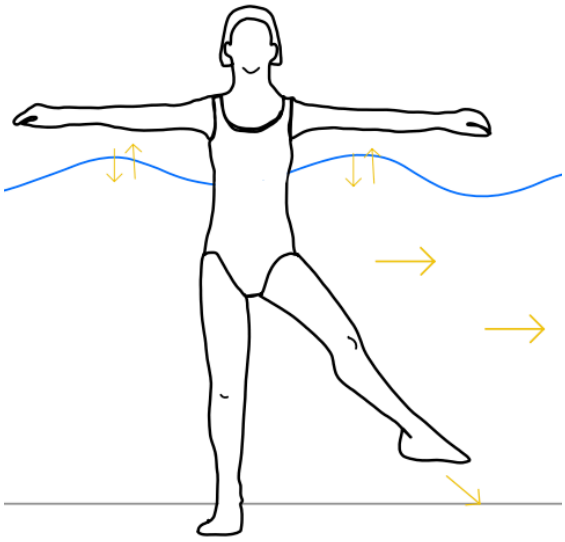
2. Side Steps, open arms out, and hold for 10 seconds	1-2 x 10		 Like the step forward and lunge, this is a sidestep, lunge and hold. Arms swing up, shoulders stay down, and engage in the core muscles. When stepping back in, continue to tighten core and glute muscles for balance and postural control while arms swing down by side.
3. Large Back Step and hold for 10 seconds	1-2 x 10		 Same as the two previous step and hold, this is a step back, with arms swinging down and back. Chest flexes towards the water and hold this position for 10 seconds. Once stepping back in, arms swing down and to the side while engaging core and tightening glutes when standing upright.

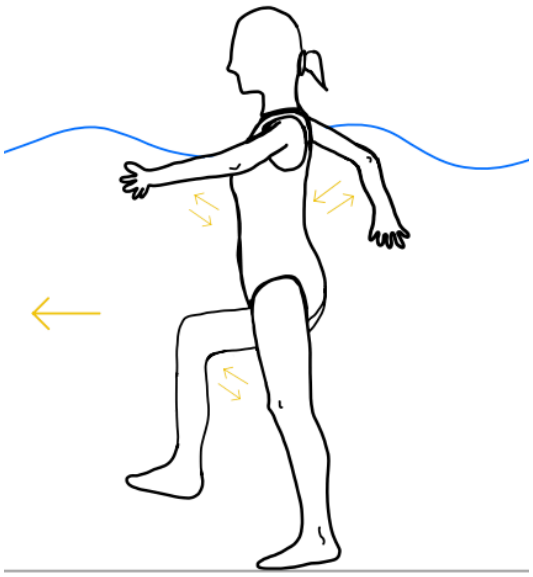
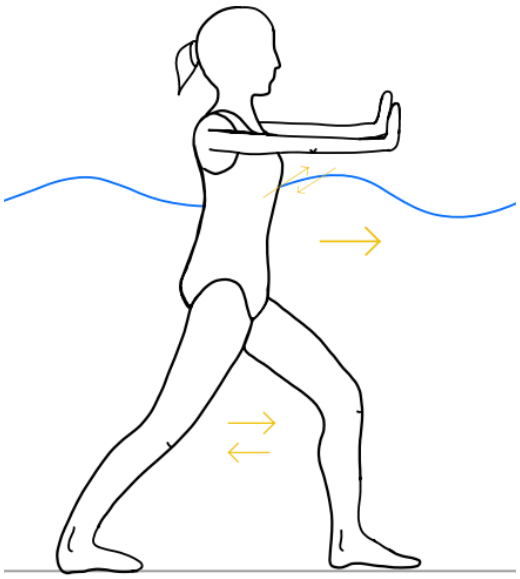
4. Rocking Horse with Arms and Legs	1-2 x 10		 Reciprocal rocking back and forth with one leg in front. The goal is to have large arm swings and bring leg up during the rock. To grade down, weight-shift only. Once finished on one leg, switch over to the other in front. Engage in core throughout.
5. Squats	1-2 x 10		 Like sitting to standing, focus on a squat where the feet are hip with apart (to grade up bring feet closer together), knees go over the big toes, and squat low. Arms swing up to water height or above head, and engage core and glues when standing back up.

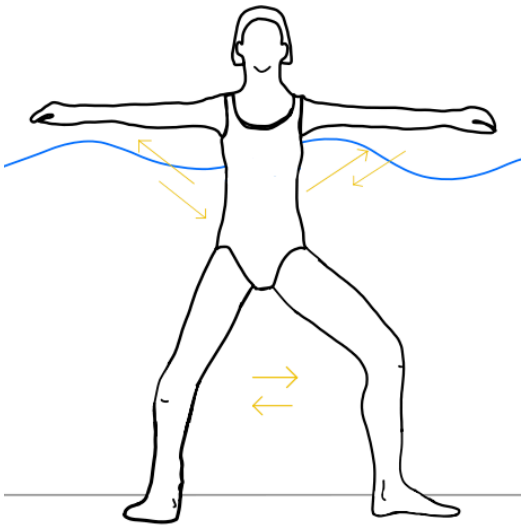
6. Single Arm Swings (both sides)	1-2 x 10		 Standing straight up, legs hip with apart (closer together to increase challenge), engage in core, arm/elbow by side and rotate forearm out to engage in shoulder external rotation then shoulder internal rotation. To grade up, use weights, resistance paddles, or adjust resistance paddles.
7. Trunk Rotations	1-2 x 10		 Similar to the stance of single arm swings, now rotate and twist trunk while reaching arms out. This will grade up to a twist and punch. Focus on balance and engaging core muscles.

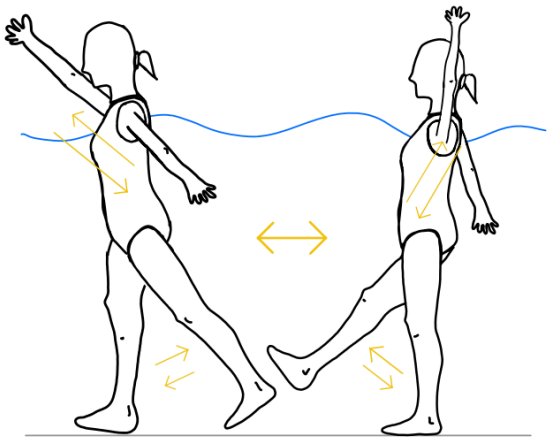
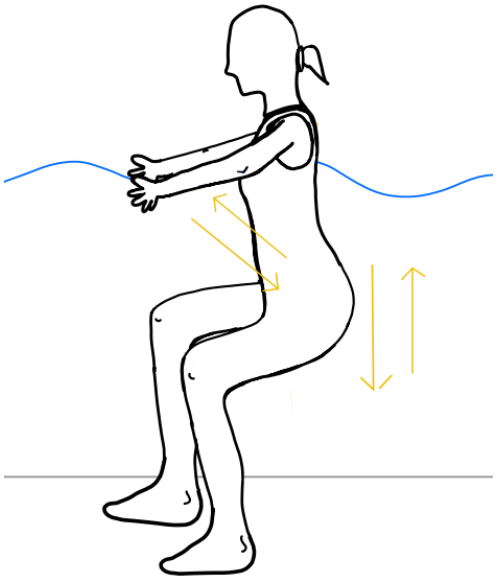
8. Heel Raises with Arm Raises	1-2 x 10		 Similar to the squat, now increase during the stand to go up onto “tippy toes” while arms swing up. Squat does not need to be as low but a good starting position to engage in core while standing up on toes. Grade up by moving legs closer together.
Stretching			
1. Spine Decompression with pool noodle	2-minute hang		 Go to deeper end, so feet cannot touch ground. Use pool noodle to float and let legs hang down towards ground, this will decompress the spine to stretch out back.
2. Cross Body Shoulder Stretch	10 seconds per side		Stretch arms in any way, suggested to cross body stretch to stretch triceps, shoulders, and back muscles that have been worked.

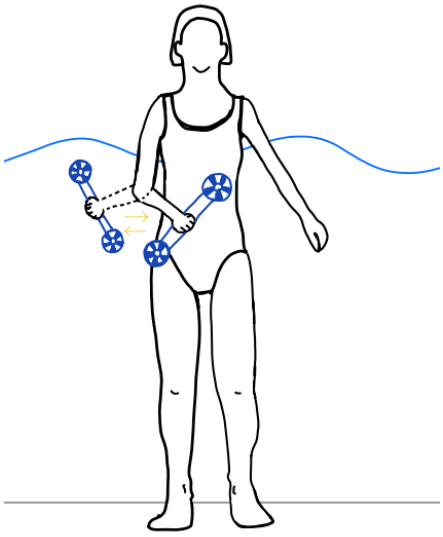
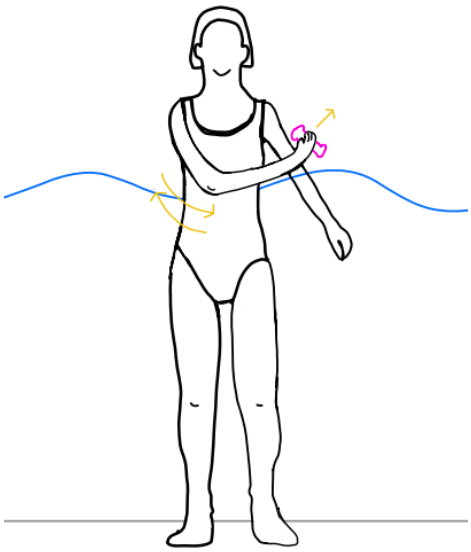
Functional Task Activity			
1. Steps to practice on stairs	1-2 x 10		Taking step up onto one step in the pool, or to use a step training step up in pool. Like marching activity, lift flexed knee up and onto step, and step other foot up, then same for stepping down. Focus is on core control, engaging in leg and glute muscles to help with balance.
2. Self-Motivating Activity	1-2 x 10		Participant chooses activity they need/want to work on that goes towards an occupation

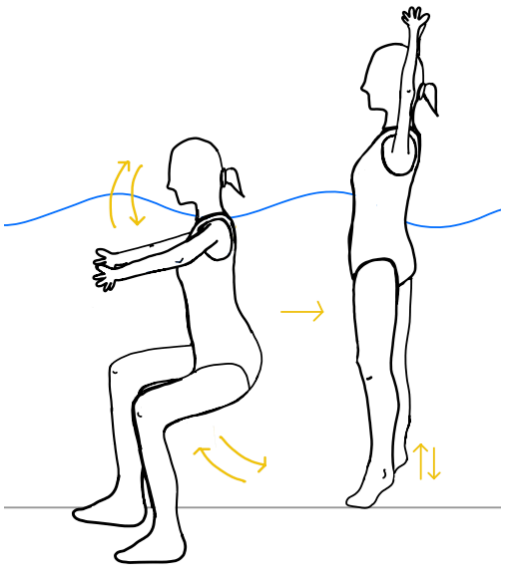
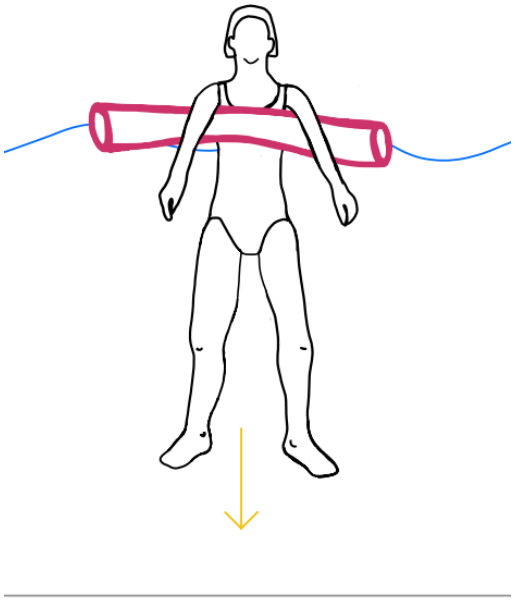
Day 2	Set and Repetitions	Grade up or down depending on level of ability	Picture and Notes
Warm Up – weights on ankles and arms (for postural stability)			
1. Forward/Backward walking	2 laps		 Large steps forward (and if possible backwards) with large amplitude arm swing
2. Sidestep walking	2 laps		 Large steps sideways with large amplitude arm swing. Arms abduct up during step and adduct down when taking step in.

3. Marching	2 laps		 Bring flexed knee up high with large arm swing, step down and repeat with other leg.
Lower and Upper Extremity **Add resistance with paddles or arm weights**			
1. Lunge step forward and hold for 10 seconds	1-2 x 10		 Similar to the beginning of the marching step, then continue to step out and swing arms in large motion up to 90 degrees, hold for 10 seconds and swing arms down to side while stepping back. Focus on core control during step back

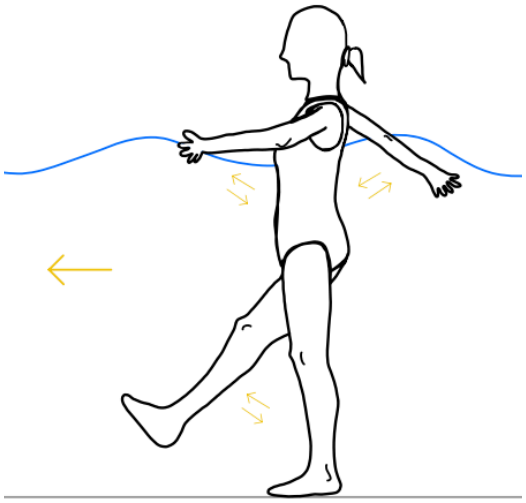
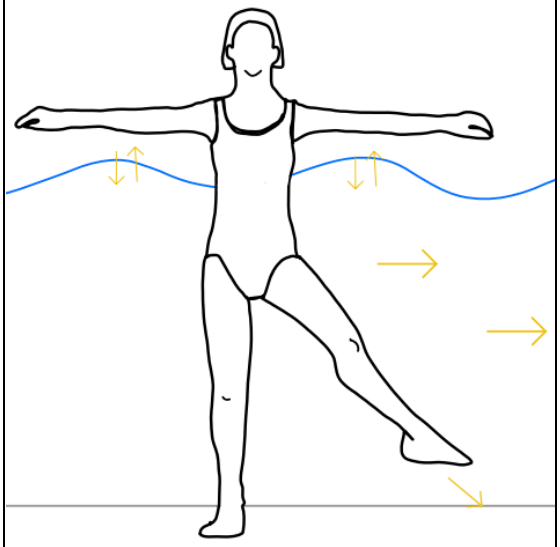
2. Side Steps, open arms out, and hold for 10 seconds	1-2 x 10		 Like the step forward and lunge, this is a sidestep, lunge and hold. Arms swing up, shoulders stay down, and engage in the core muscles. When stepping back in, continue to tighten core and glute muscles for balance and postural control while arms swing down by side.
3. Large Back Step and hold for 10 seconds	1-2 x 10		 Same as the two previous step and hold, this is a step back, with arms swinging down and back. Chest flexes towards the water and hold this position for 10 seconds. Once stepping back in, arms swing down and to the side while engaging core and tightening glutes when standing upright.

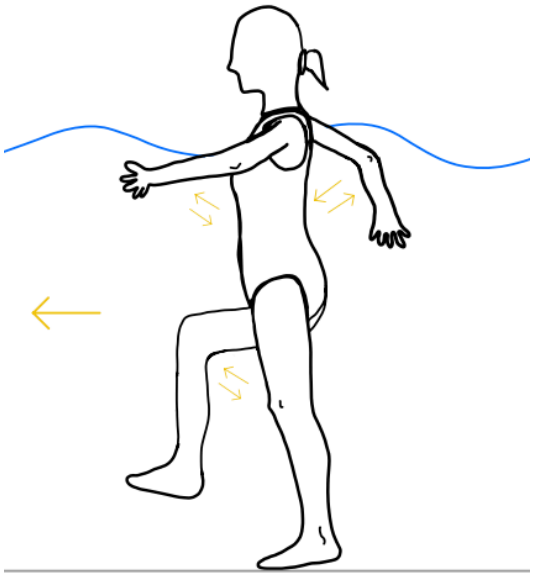
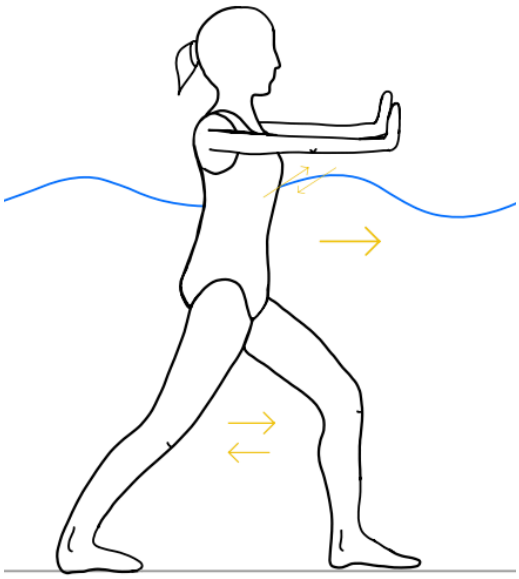
4. Rocking Horse with Arms and Legs	1-2 x 10		 Reciprocal rocking back and forth with one leg in front. The goal is to have large arm swings and bring leg up during the rock. To grade down, weight-shift only. Once finished on one leg, switch over to the other in front. Engage in core throughout.
5. Squats	1-2 x 10		 Like sitting to standing, focus on a squat where the feet are hip with apart (to grade up bring feet closer together), knees go over the big toes, and squat low. Arms swing up to water height or above head, and engage core and glues when standing back up.

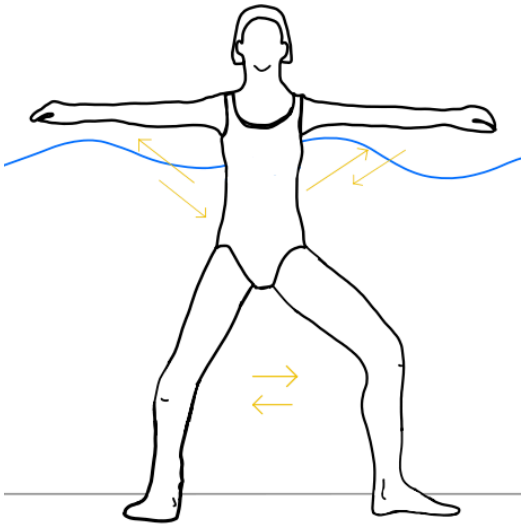
6. Single Arm Swings (both sides)	1-2 x 10		 Standing straight up, legs hip with apart (closer together to increase challenge), engage in core, arm/elbow by side and rotate forearm out to engage in shoulder external rotation then shoulder internal rotation. To grade up, use weights, resistance paddles, or adjust resistance paddles.
7. Trunk Rotations	1-2 x 10		 Similar to the stance of single arm swings, now rotate and twist trunk while reaching arms out. This will grade up to a twist and punch. Focus on balance and engaging core muscles.

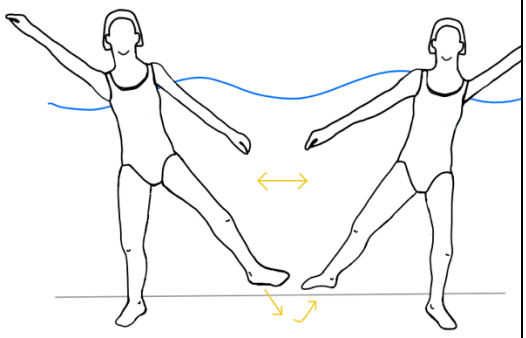
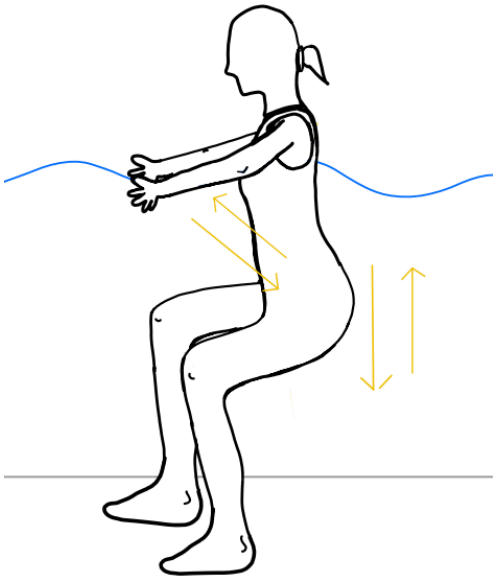
8. Heel Raises with Arm Raises	1-2 x 10		 Similar to the squat, now increase during the stand to go up onto “tippy toes” while arms swing up. Squat does not need to be as low but a good starting position to engage in core while standing up on toes. Grade up by moving legs closer together.
Stretching			
1. Spine Decompression with pool noodle	2-minute hang		 Go to deeper end, so feet cannot touch ground. Use pool noodle to float and let legs hang down towards ground, this will decompress the spine to stretch out back.

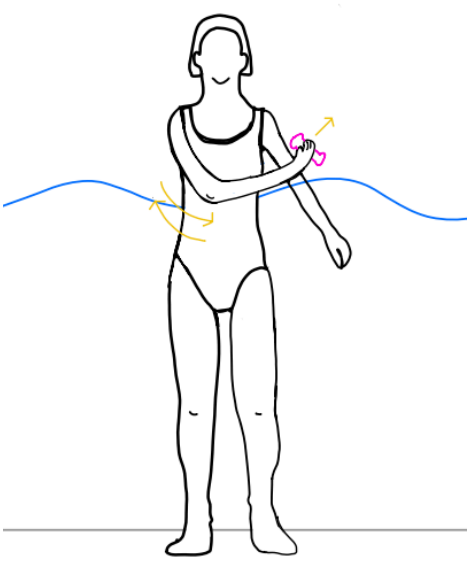
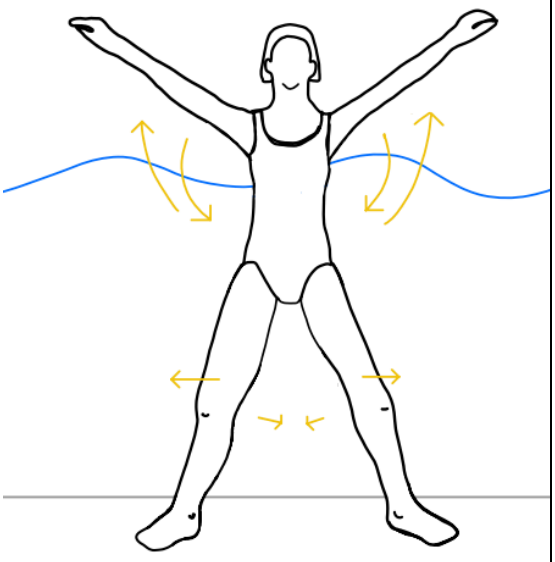
2. Cross Body Shoulder Stretch	10 seconds per side		Stretch arms in any way, suggested to cross body stretch to stretch triceps, shoulders, and back muscles that have been worked.
Functional Task Activity			
1. Steps to practice on stairs	1-2 x 10		Taking step up onto one step in the pool, or to use a step training step up in pool. Like marching activity, lift flexed knee up and onto step, and step other foot up, then same for stepping down. Focus is on core control, engaging in leg and glute muscles to help with balance.
2. Self-Motivating Activity	1-2 x 10		Participant chooses activity they need/want to work on that goes towards an occupation

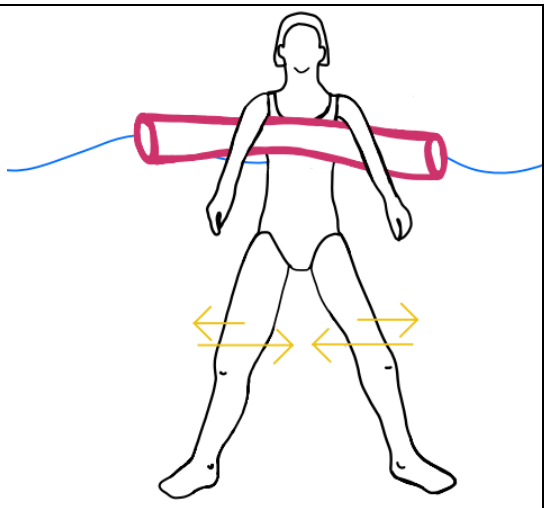
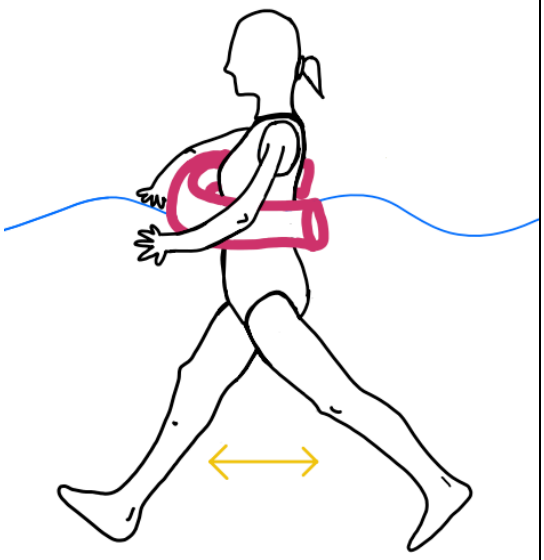
Day 3	Set and Repetitions	Grade up or down depending on level of ability	Picture and Notes
Warm Up – weights on ankles and arms (for postural stability)			
1. Forward/Backward walking	2 laps		 Large steps forward (and if possible backwards) with large amplitude arm swing
2. Sidestep walking	2 laps		 Large steps sideways with large amplitude arm swing. Arms abduct up during step and adduct down when taking step in.

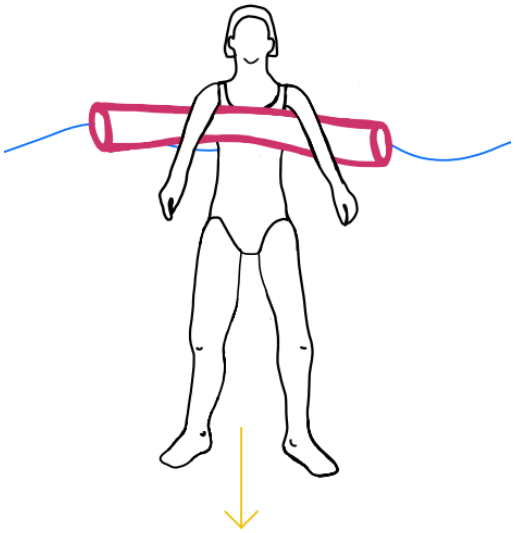
3. Marching	2 laps		 Bring flexed knee up high with large arm swing, step down and repeat with other leg.
Lower and Upper Extremity			
1. Lunge step forward and hold for 10 seconds	1-2 x 10		 Similar to the beginning of the marching step, then continue to step out and swing arms in large motion up to 90 degrees, hold for 10 seconds and swing arms down to side while stepping back. Focus on core control during step back

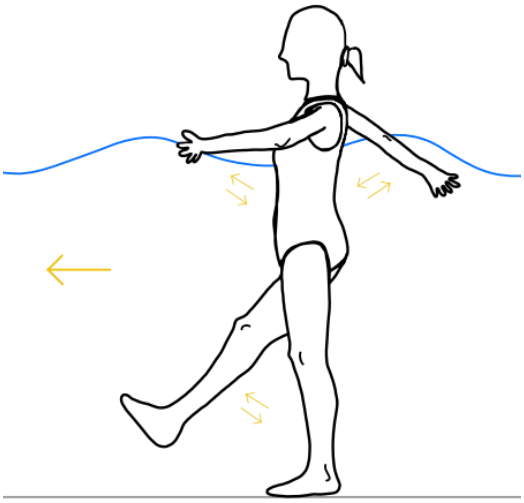
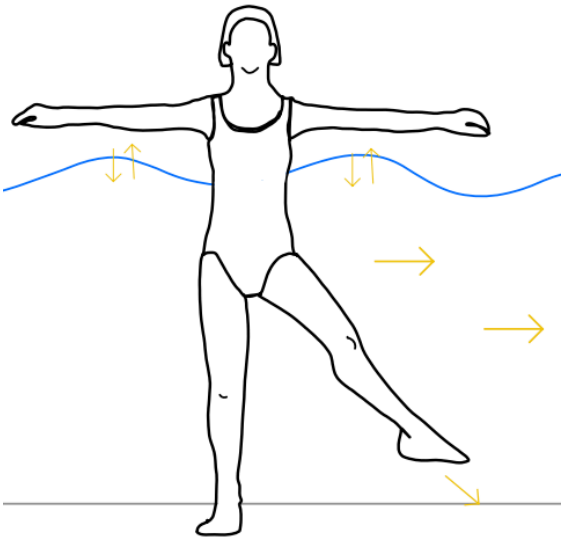
2. Side Steps, open arms out, and hold for 10 seconds	1-2 x 10		 Like the step forward and lunge, this is a sidestep, lunge and hold. Arms swing up, shoulders stay down, and engage in the core muscles. When stepping back in, continue to tighten core and glute muscles for balance and postural control while arms swing down by side.
3. Large Back Step and hold for 10 seconds	1-2 x 10		 Same as the two previous step and hold, this is a step back, with arms swinging down and back. Chest flexes towards the water and hold this position for 10 seconds. Once stepping back in, arms swing down and to the side while engaging core and tightening glutes when standing upright.

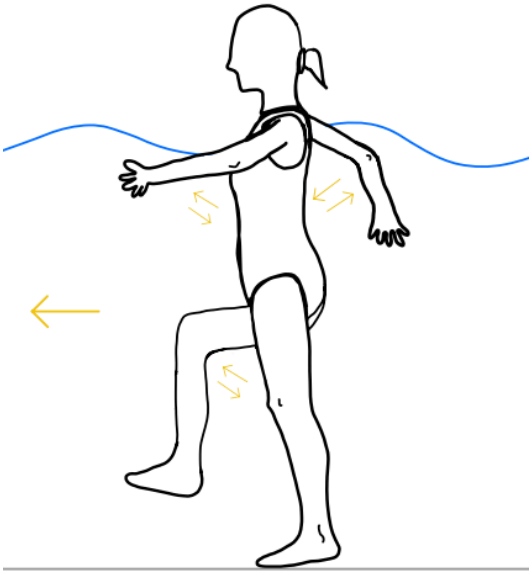
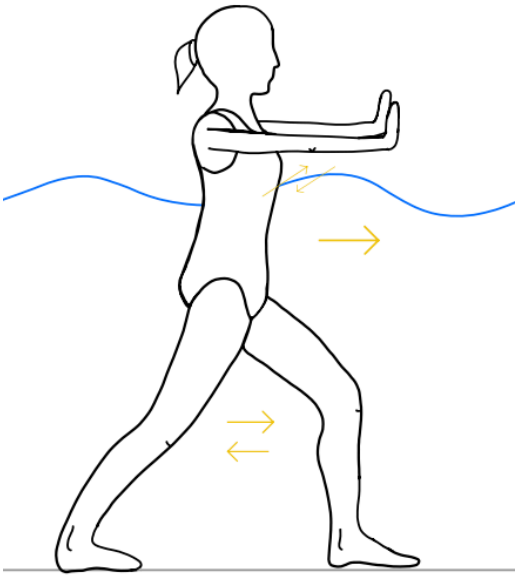
4. Side Rocking Horse with Arms up and Legs abducted	1-2 x 10		 Similar to the front rocking horse, this is the same but sideways. The goal is to have large arm swings and bring leg up during the rock. To grade down, weight-shift only. Engage in core muscles.
5. Squats with arms in forward reach	1-2 x 10		 Like sitting to standing, focus on a squat where the feet are hip with apart (to grade up bring feet closer together), knees go over the big toes, and squat low. Arms swing up to above head now (if not done in previous week), and engage core and glues when standing back up.

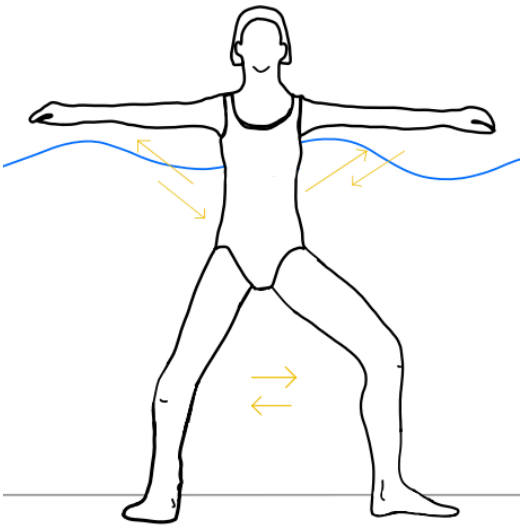
6. Twist and reach	1-2 x 10		 Same as trunk rotations in previous week, now rotate and twist trunk while reaching arms out. OT will use something as a target for further reaching. This will grade up to a twist and full punch. Focus on balance and engaging core muscles.
7. Star fish (arms and legs extend) and close body in a squat	1-2 x 10	Grade down to step out and move up arms one at a time "out, out, in, in, repeat"	 Starting in a neutral stance, then jump and bring legs out and arms up. This is similar to a jumping jack, focus is on the hold for 2-3 seconds once jumped out and bringing extremities back together.

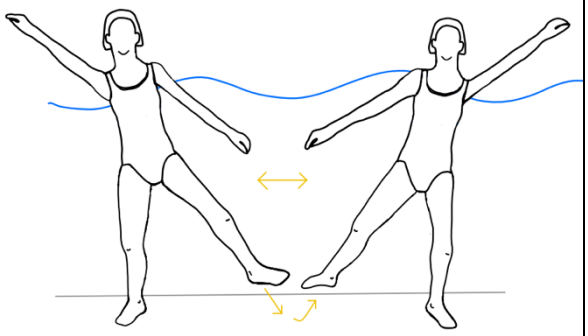
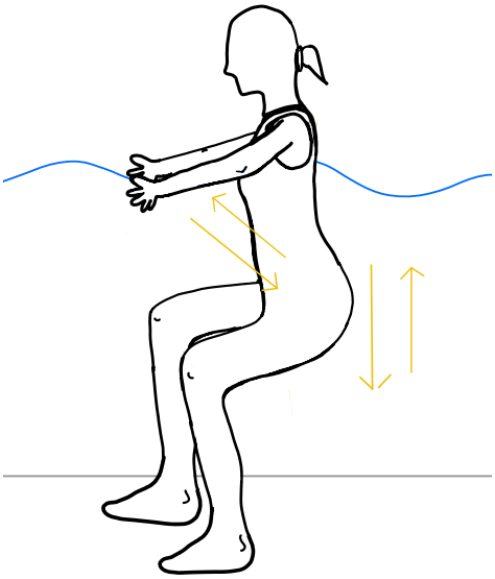
8. Noodle Float and leg kicks (ski and starfish)	1-2 x 10 each		 and  Floating like the spinal decompression, now engage legs in abduction/adduction and flexion/extension to create starfish and skier like movements. Engaging in the core muscles will help keep the body steady as the lower extremities move and not float up.

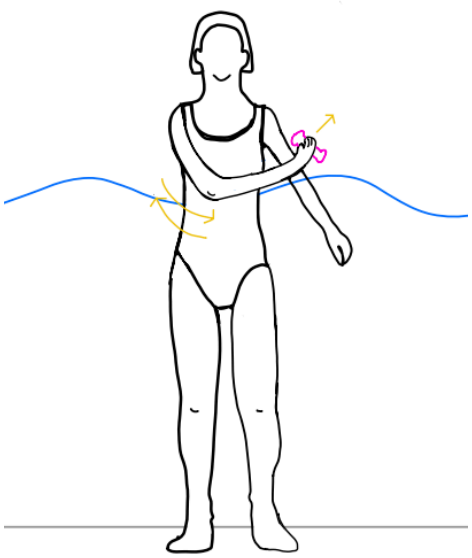
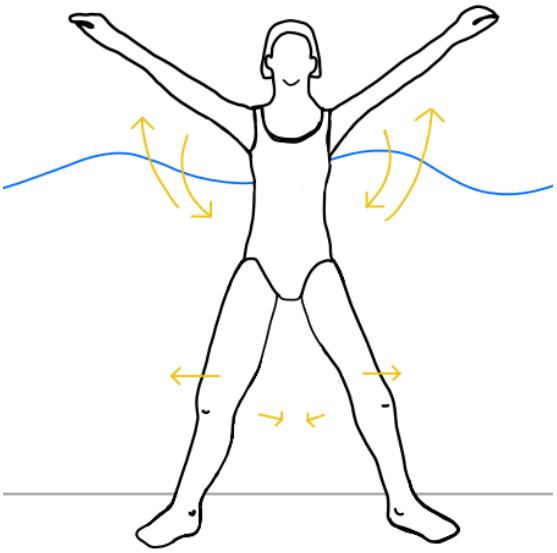
Stretching			
1. Spine Decompression with pool noodle	2-minute hang		 Go to deeper end, so feet cannot touch ground. Use pool noodle to float and let legs hang down towards ground, this will decompress the spine to stretch out back.
2. Cross Body Shoulder Stretch	10 seconds per side		Stretch arms in any way, suggested to cross body stretch to stretch triceps, shoulders, and back muscles that have been worked.
Functional Task Activity			
1. Steps to practice on stairs	1-2 x 10		Taking step up onto one step in the pool, or to use a step training step up in pool. Like marching activity, lift flexed knee up and onto step, and step other foot up, then same for stepping down. Focus is on core control, engaging in leg and glute muscles to help with balance.
2. Self-Motivating Activity	1-2 x 10		Participant chooses activity they need/want to work on that goes towards an occupation

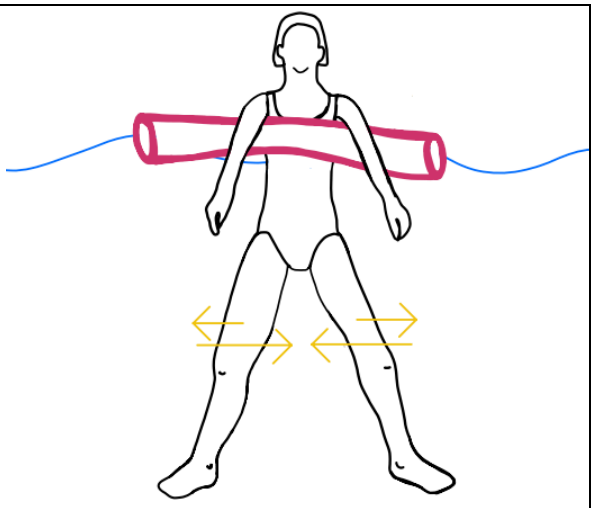
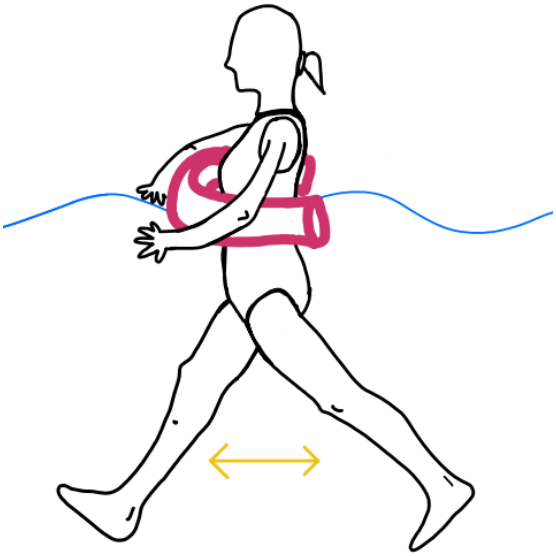
Day 4	Set and Repetitions	Grade up or down depending on level of ability	Picture and Notes
Warm Up – weights on ankles and arms (for postural stability)			
1. Forward/Backward walking	2 laps		 Large steps forward (and if possible backwards) with large amplitude arm swing
2. Sidestep walking	2 laps		 Large steps sideways with large amplitude arm swing. Arms abduct up during step and adduct down when taking step in.

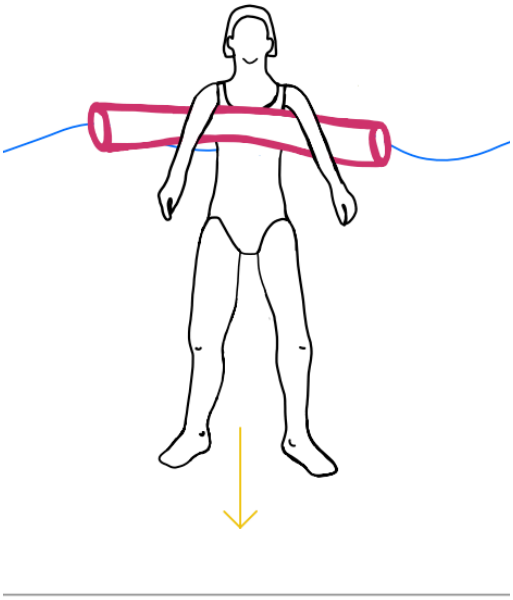
3. Marching	2 laps		 Bring flexed knee up high with large arm swing, step down and repeat with other leg.
Lower and Upper Extremity			
1. Lunge step forward and hold for 10 seconds	1-2 x 10		 Similar to the beginning of the marching step, then continue to step out and swing arms in large motion up to 90 degrees, hold for 10 seconds and swing arms down to side while stepping back. Focus on core control during step back

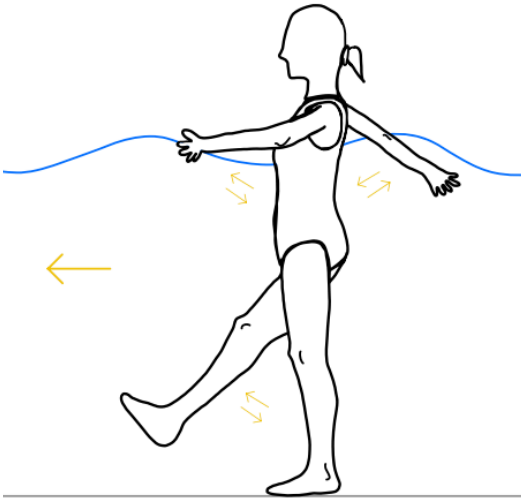
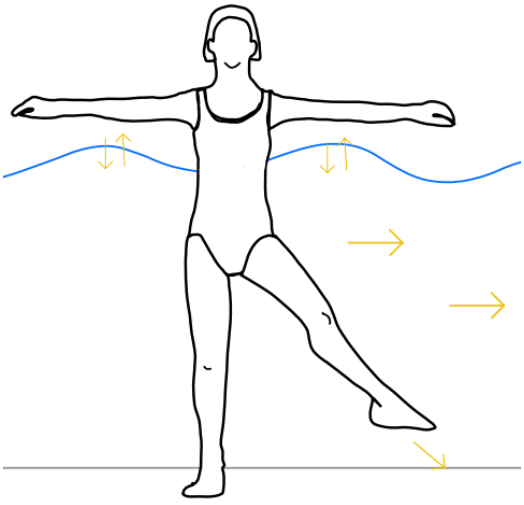
2. Side Steps, open arms out, and hold for 10 seconds	1-2 x 10		 Like the step forward and lunge, this is a sidestep, lunge and hold. Arms swing up, shoulders stay down, and engage in the core muscles. When stepping back in, continue to tighten core and glute muscles for balance and postural control while arms swing down by side.
3. Large Back Step and hold for 10 seconds	1-2 x 10		 Same as the two previous step and hold, this is a step back, with arms swinging down and back. Chest flexes towards the water and hold this position for 10 seconds. Once stepping back in, arms swing down and to the side while engaging core and tightening glutes when standing upright.

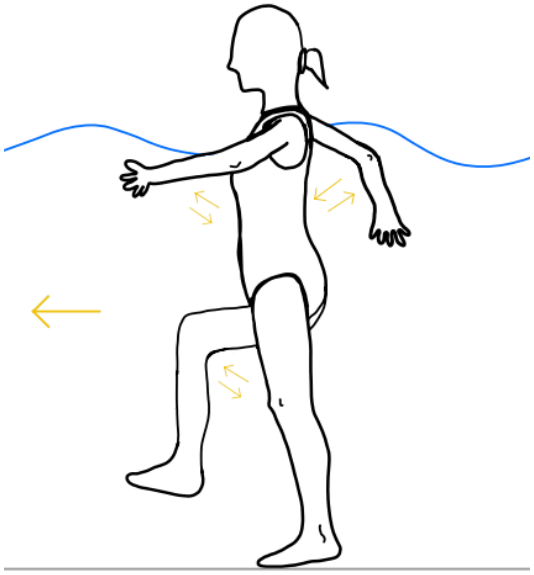
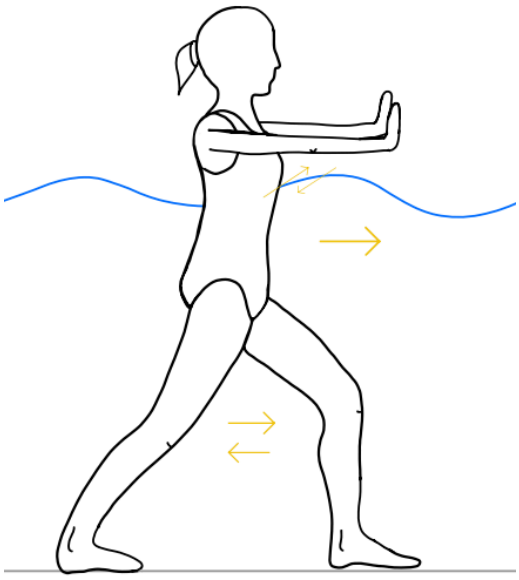
4. Side Rocking Horse with Arms up and Legs abducted	1-2 x 10		 Similar to the front rocking horse, this is the same but sideways. The goal is to have large arm swings and bring leg up during the rock. To grade down, weight-shift only. Engage in core muscles.
5. Squats with arms in forward reach	1-2 x 10		 Like sitting to standing, focus on a squat where the feet are hip with apart (to grade up bring feet closer together), knees go over the big toes, and squat low. Arms swing up to above head now (if not done in previous week), and engage core and glues when standing back up.

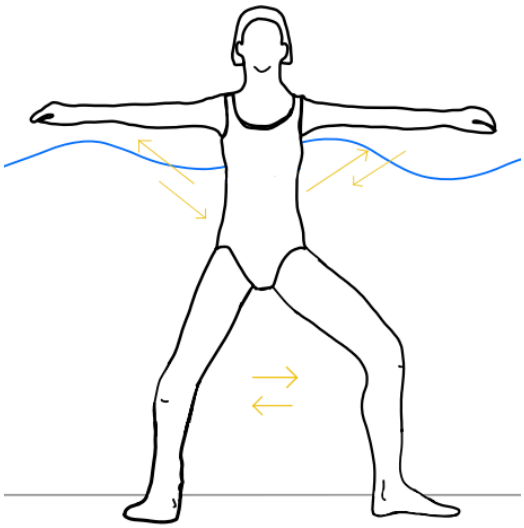
6. Twist and reach	1-2 x 10		 Same as trunk rotations in previous week, now rotate and twist trunk while reaching arms out. Upgrade to full punch, with or without weights for this week. Focus on balance and engaging core muscles, and large explosion during punch.
7. Star fish (arms and legs extend) and close body in a squat	1-2 x 10	Grade down to step out and move up arms one at a time "out, out, in, in, repeat"	 Starting in a neutral stance, then jump and bring legs out and arms up. This is similar to a jumping jack, focus is on the hold for 2-3 seconds once jumped out and bringing extremities back together.

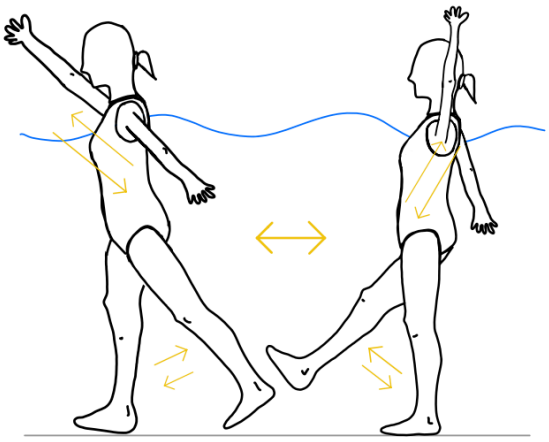
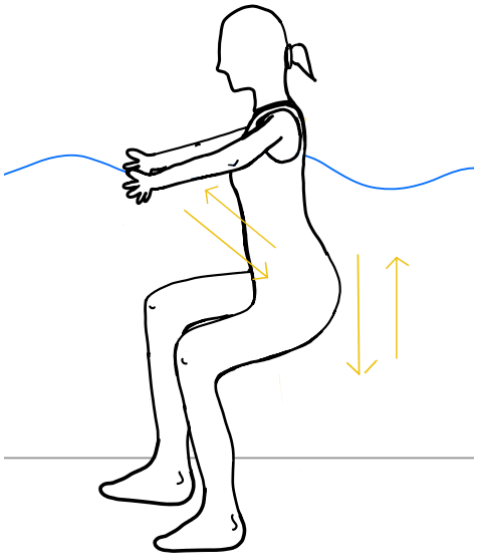
8. Noodle Float and leg kicks (ski and starfish)	1-2 x 10 each		 and  Floating like the spinal decompression, now engage legs in abduction/adduction and flexion/extension to create starfish and skier like movements. Engaging in the core muscles will help keep the body steady as the lower extremities move and not float up.

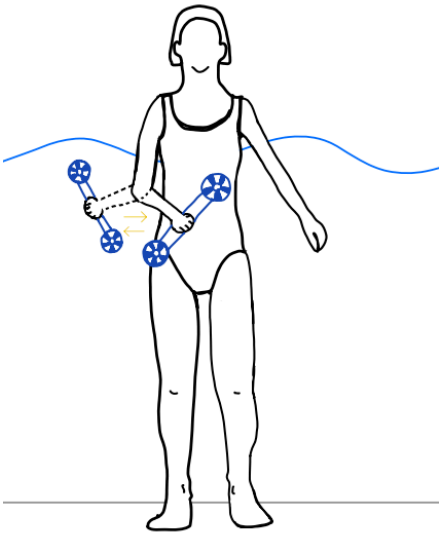
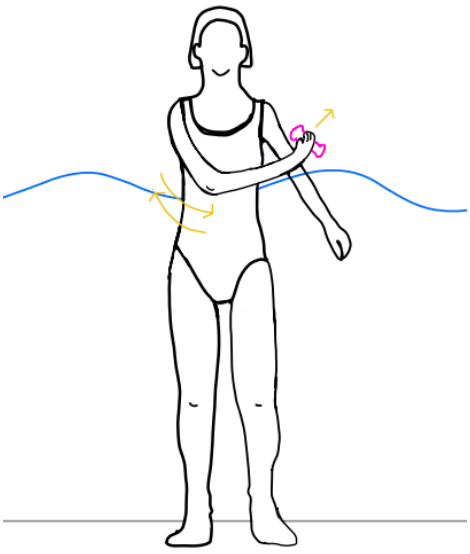
Stretching			
3. Spine Decompression with pool noodle	2-minute hang		 Go to deeper end, so feet cannot touch ground. Use pool noodle to float and let legs hang down towards ground, this will decompress the spine to stretch out back.
4. Cross Body Shoulder Stretch	10 seconds per side		Stretch arms in any way, suggested to cross body stretch to stretch triceps, shoulders, and back muscles that have been worked.
Functional Task Activity			
1. Steps to practice on stairs	1-2 x 10		Taking step up onto one step in the pool, or to use a step training step up in pool. Like marching activity, lift flexed knee up and onto step, and step other foot up, then same for stepping down. Focus is on core control, engaging in leg and glute muscles to help with balance.
2. Self-Motivating Activity	1-2 x 10		Participant chooses activity they need/want to work on that goes towards an occupation

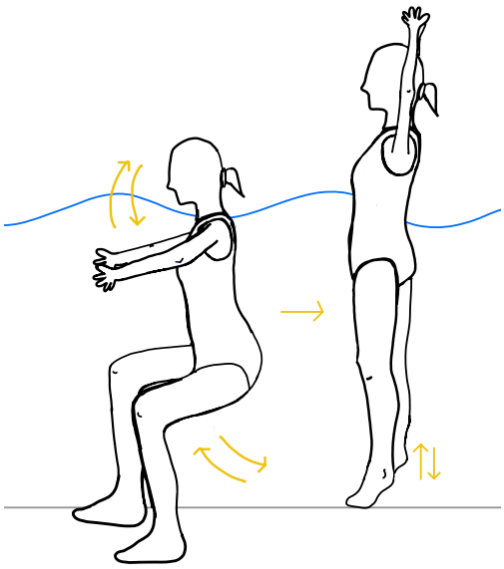
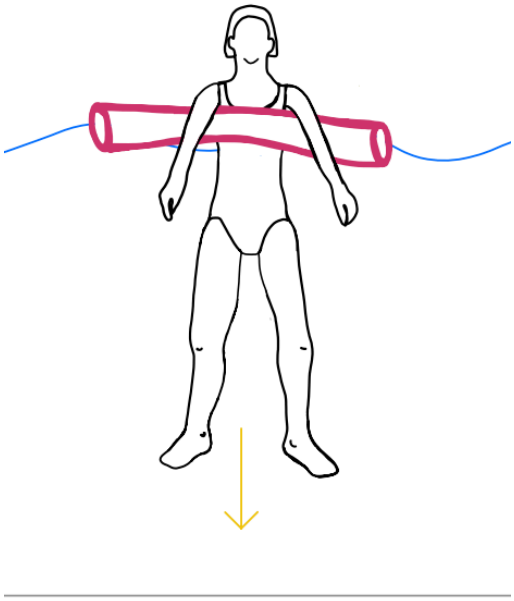
Day 5	Set and Repetitions	Grade up or down depending on level of ability	Picture and Notes
Warm Up – weights on ankles and arms (for postural stability)			
1. Forward/ Backward walking	2 laps		 Large steps forward (and if possible backwards) with large amplitude arm swing
2. Sidestep walking	2 laps		 Large steps sideways with large amplitude arm swing. Arms abduct up during step and adduct down when taking step in.

3. Marching	2 laps		 Bring flexed knee up high with large arm swing, step down and repeat with other leg.
Lower and Upper Extremity **Add resistance with paddles or arm weights**			
1. Lunge step forward and hold for 10 seconds	1-2 x 10		 Similar to the beginning of the marching step, then continue to step out and swing arms in large motion up to 90 degrees, hold for 10 seconds and swing arms down to side while stepping back. Focus on core control during step back

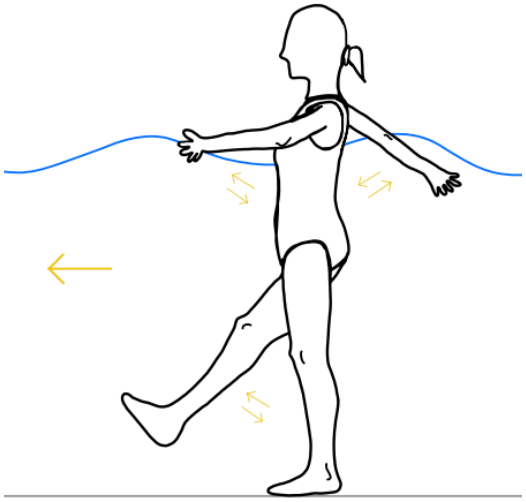
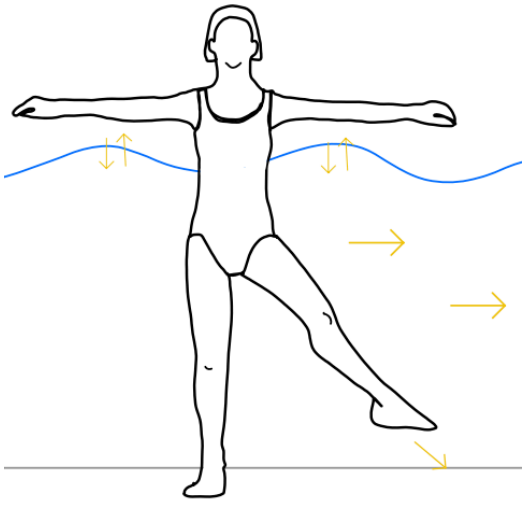
2. Side Steps, open arms out, and hold for 10 seconds	1-2 x 10		 Like the step forward and lunge, this is a sidestep, lunge and hold. Arms swing up, shoulders stay down, and engage in the core muscles. When stepping back in, continue to tighten core and glute muscles for balance and postural control while arms swing down by side.
3. Large Back Step and hold for 10 seconds	1-2 x 10		 Same as the two previous step and hold, this is a step back, with arms swinging down and back. Chest flexes towards the water and hold this position for 10 seconds. Once stepping back in, arms swing down and to the side while engaging core and tightening glutes when standing upright.

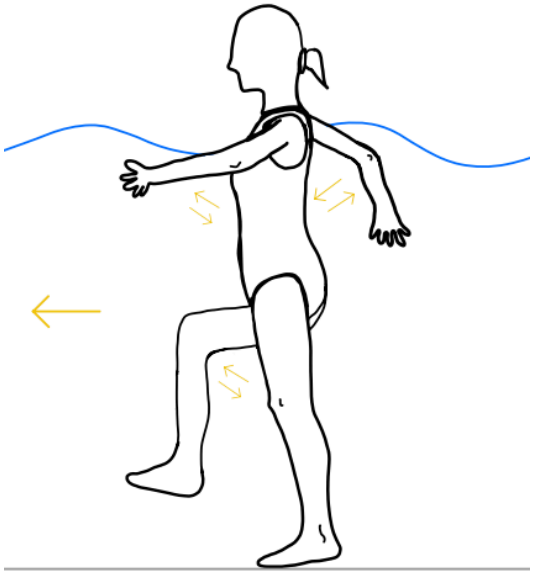
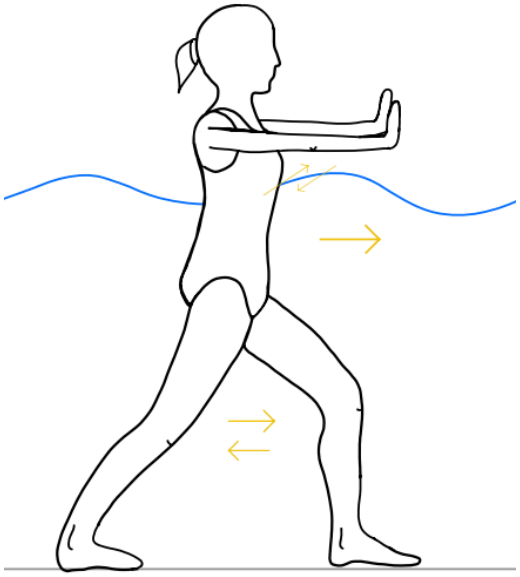
4. Rocking Horse with Arms and Legs	1-2 x 10		 Reciprocal rocking back and forth with one leg in front. The goal is to have large arm swings and bring leg up during the rock. To grade down, weight-shift only. Once finished on one leg, switch over to the other in front. Engage in core throughout.
5. Squats	1-2 x 10		 Like sitting to standing, focus on a squat where the feet are hip with apart (to grade up bring feet closer together), knees go over the big toes, and squat low. Arms swing up to water height or above head, and engage core and glues when standing back up.

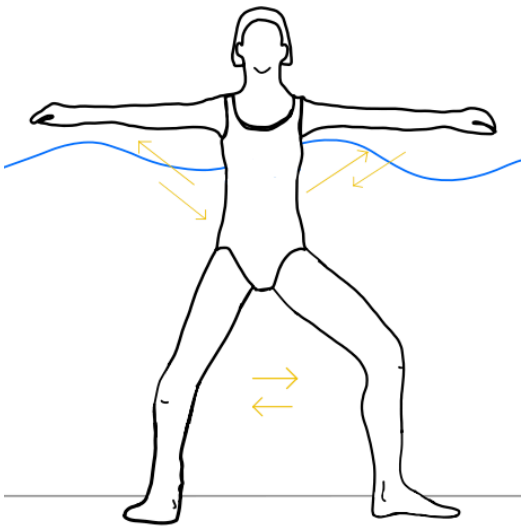
6. Single Arm Swings (both sides)	1-2 x 10		 Standing straight up, legs hip with apart (closer together to increase challenge), engage in core, arm/elbow by side and rotate forearm out to engage in shoulder external rotation then shoulder internal rotation. To grade up, use weights, resistance paddles, or adjust resistance paddles.
7. Trunk Rotations	1-2 x 10	Use noodle to hit water – external que	 Similar to the stance of single arm swings, now rotate and twist trunk while reaching arms out. This will grade up to a twist and punch. Focus on balance and engaging core muscles.

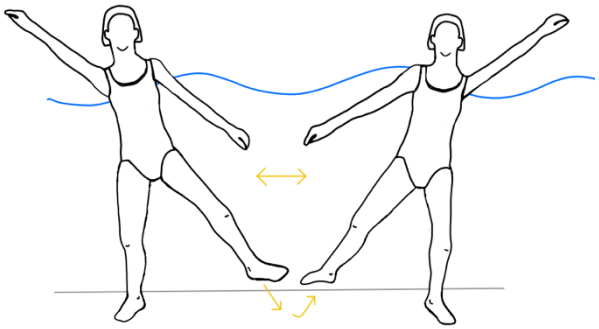
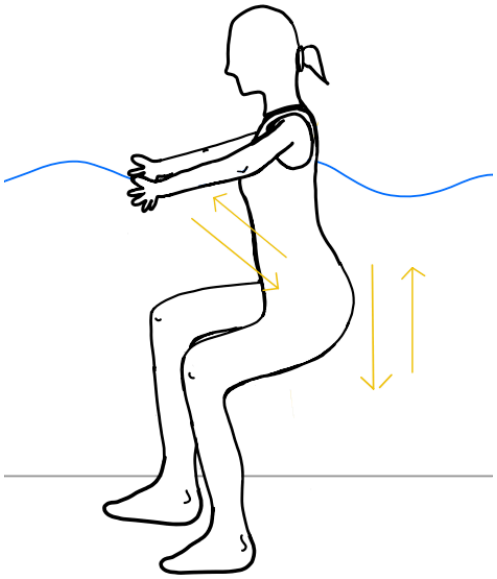
8. Heel Raises with Arm Raises	1-2 x 10	Reach for external target – grade up if they can jump	 Similar to the squat, now increase during the stand to go up onto "tippy toes" while arms swing up. Squat does not need to be as low but a good starting position to engage in core while standing up on toes. Grade up by moving legs closer together.
Stretching			
3. Spine Decompression with pool noodle	2-minute hang		 Go to deeper end, so feet cannot touch ground. Use pool noodle to float and let legs hang down towards ground, this will decompress the spine to stretch out back.

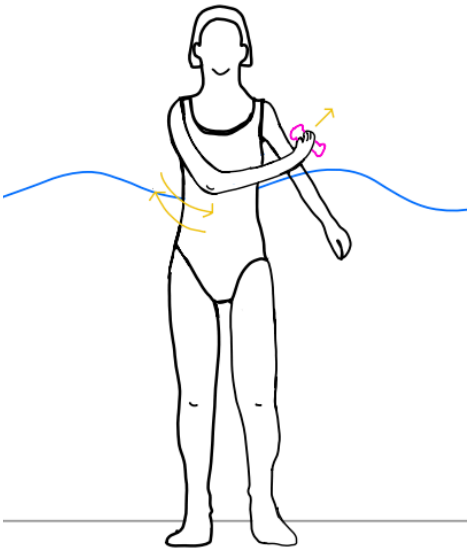
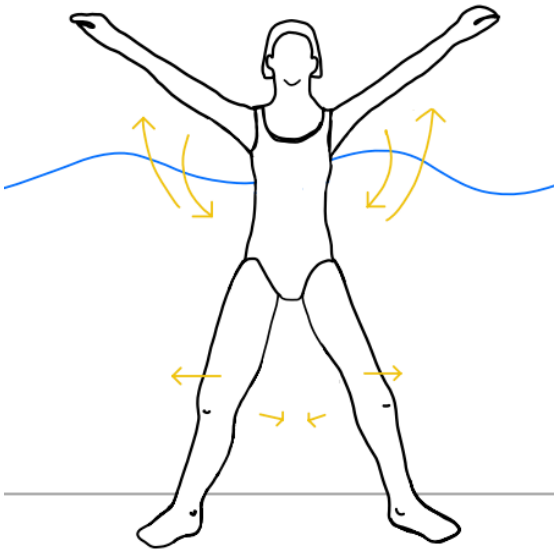
4. Cross Body Shoulder Stretch	10 seconds per side		Stretch arms in any way, suggested to cross body stretch to stretch triceps, shoulders, and back muscles that have been worked.
Functional Task Activity			
3. Steps to practice on stairs	1-2 x 10		Taking step up onto one step in the pool, or to use a step training step up in pool. Like marching activity, lift flexed knee up and onto step, and step other foot up, then same for stepping down. Focus is on core control, engaging in leg and glute muscles to help with balance.
4. Self-Motivating Activity	1-2 x 10		Participant chooses activity they need/want to work on that goes towards an occupation

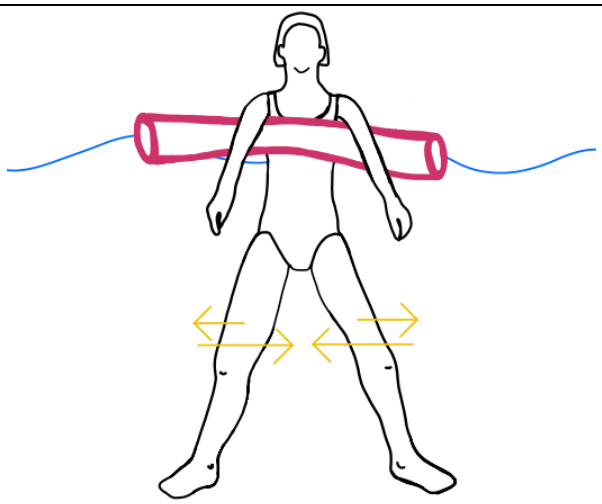
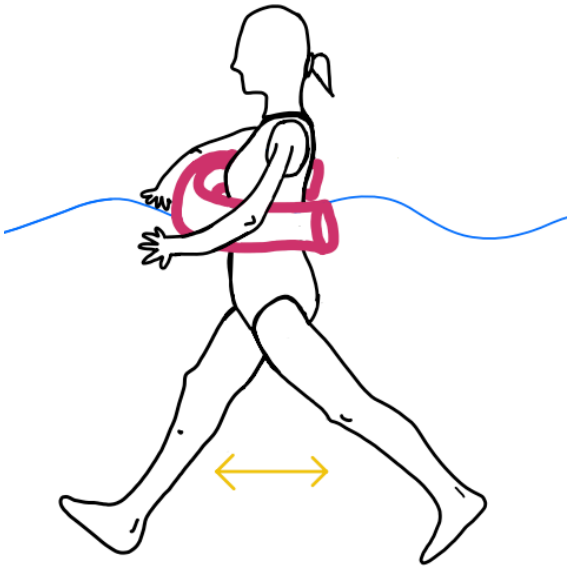
Day 6	Set and Repetitions	Grade up or down depending on level of ability	Picture and Notes
Warm Up – weights on ankles and arms (for postural stability)			
1. Forward/Backward walking	2 laps		 Large steps forward (and if possible backwards) with large amplitude arm swing
2. Sidestep walking	2 laps		 Large steps sideways with large amplitude arm swing. Arms abduct up during step and adduct down when taking step in.

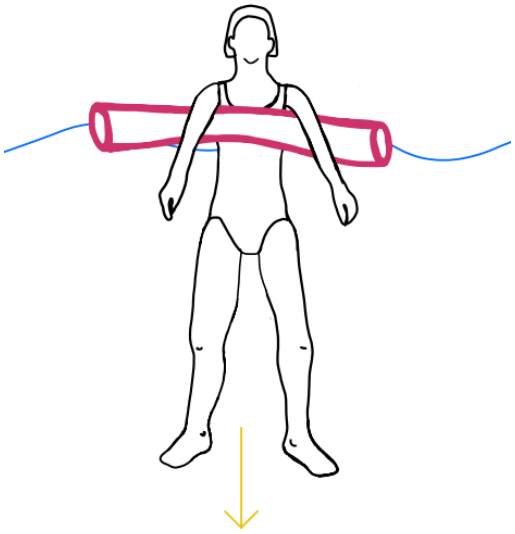
3. Marching	2 laps		 Bring flexed knee up high with large arm swing, step down and repeat with other leg.
Lower and Upper Extremity			
1. Lunge step forward and hold for 10 seconds	1-2 x 10		 Similar to the beginning of the marching step, then continue to step out and swing arms in large motion up to 90 degrees, hold for 10 seconds and swing arms down to side while stepping back. Focus on core control during step back

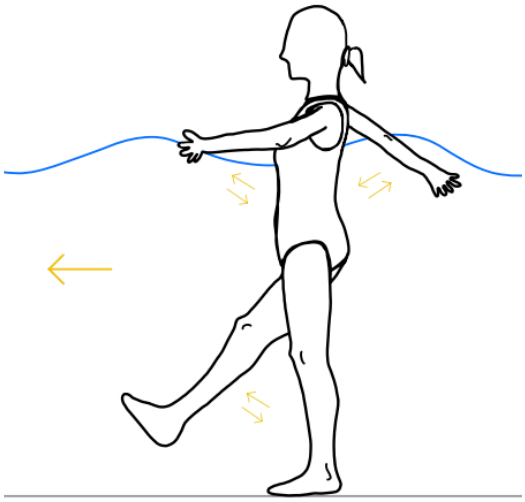
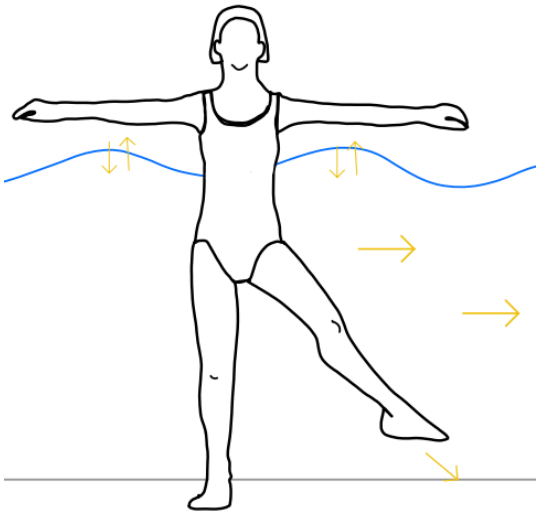
2. Side Steps, open arms out, and hold for 10 seconds	1-2 x 10		 Like the step forward and lunge, this is a sidestep, lunge and hold. Arms swing up, shoulders stay down, and engage in the core muscles. When stepping back in, continue to tighten core and glute muscles for balance and postural control while arms swing down by side.
3. Large Back Step and hold for 10 seconds	1-2 x 10		 Same as the two previous step and hold, this is a step back, with arms swinging down and back. Chest flexes towards the water and hold this position for 10 seconds. Once stepping back in, arms swing down and to the side while engaging core and tightening glutes when standing upright.

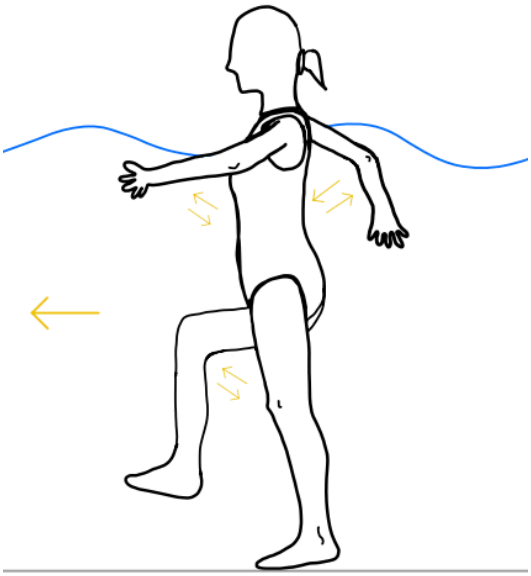
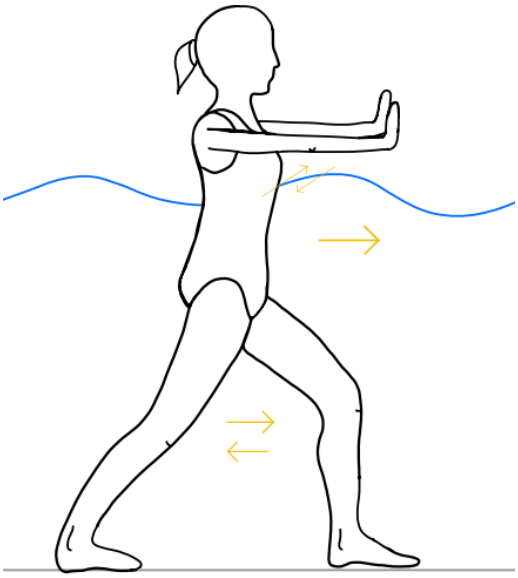
4. Side Rocking Horse with Arms up and Legs abducted	1-2 x 10		 Similar to the front rocking horse, this is the same but sideways. The goal is to have large arm swings and bring leg up during the rock. To grade down, weight-shift only. Engage in core muscles.
5. Squats with arms in forward reach	1-2 x 10		 Like sitting to standing, focus on a squat where the feet are hip with apart (to grade up bring feet closer together), knees go over the big toes, and squat low. Arms swing up to above head now (if not done in previous week), and engage core and glues when standing back up.

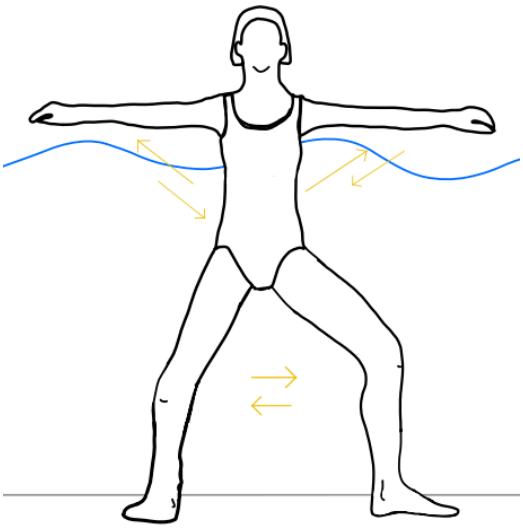
6. Twist and reach	1-2 x 10		 Same as trunk rotations in previous week, now rotate and twist trunk while reaching arms out. Upgrade to full punch, with or without weights for this week. Focus on balance and engaging core muscles, and large explosion during punch.
7. Star fish (arms and legs extend) and close body in a squat	1-2 x 10	Grade down to step out and move up arms one at a time "out, out, in, in, repeat"	 Starting in a neutral stance, then jump and bring legs out and arms up. This is similar to a jumping jack, focus is on the hold for 2-3 seconds once jumped out and bringing extremities back together.

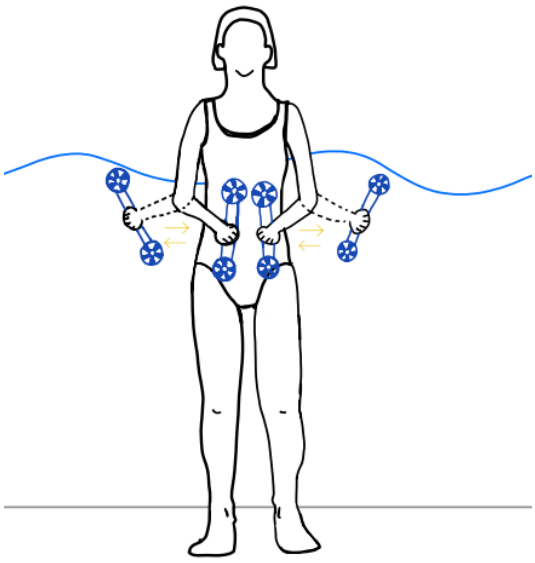
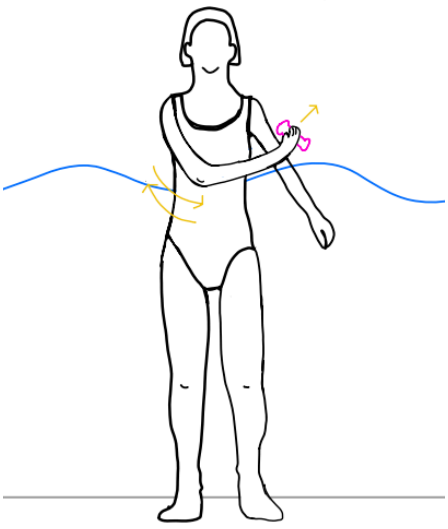
8. Noodle Float and leg kicks (ski and starfish)	1-2 x 10 each		 and  Floating like the spinal decompression, now engage legs in abduction/adduction and flexion/extension to create starfish and skier like movements. Engaging in the core muscles will help keep the body steady as the lower extremities move and not float up.

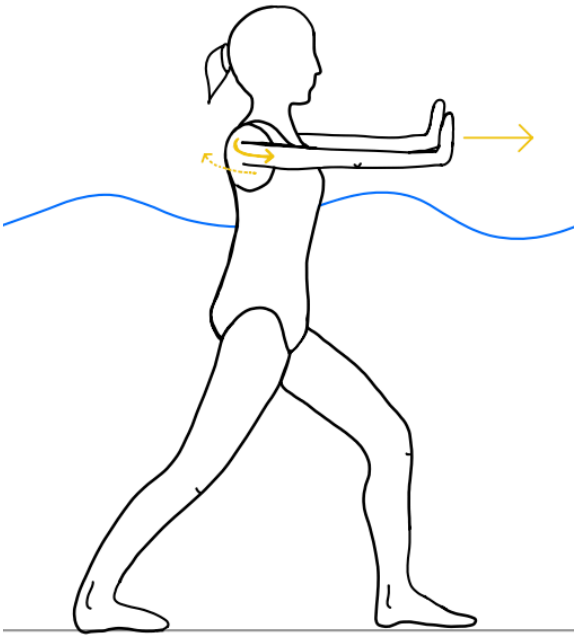
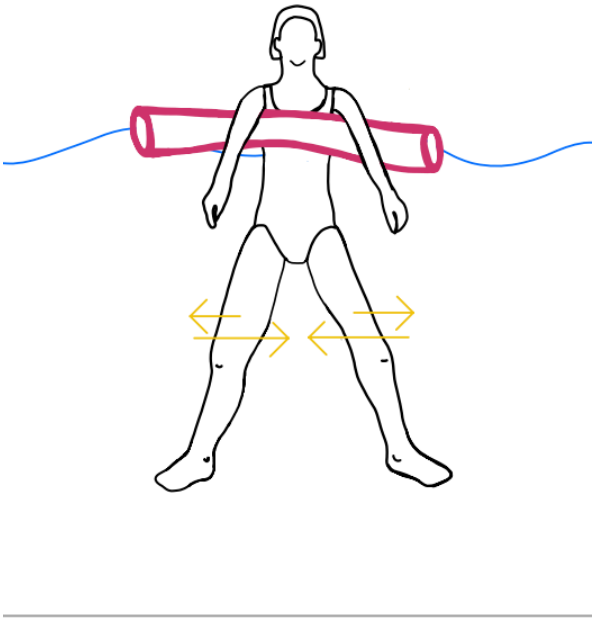
Stretching			
1. Spine Decompression with pool noodle	2-minute hang		 Go to deeper end, so feet cannot touch ground. Use pool noodle to float and let legs hang down towards ground, this will decompress the spine to stretch out back.
2. Cross Body Shoulder Stretch	10 seconds per side		Stretch arms in any way, suggested to cross body stretch to stretch triceps, shoulders, and back muscles that have been worked.
Functional Task Activity			
1. Steps to practice on stairs	1-2 x 10		Taking step up onto one step in the pool, or to use a step training step up in pool. Like marching activity, lift flexed knee up and onto step, and step other foot up, then same for stepping down. Focus is on core control, engaging in leg and glute muscles to help with balance.
2. Self-Motivating Activity	1-2 x 10		Participant chooses activity they need/want to work on that goes towards an occupation

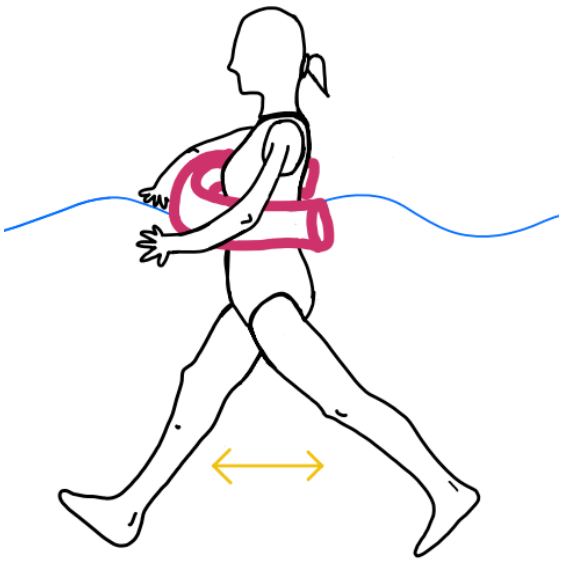
Day 7	Set and Repetitions	Grade up or down depending on level of ability	Picture and Notes
Warm Up – weights on ankles and arms (for postural stability)			
1. Forward/Back ward walking	2 laps		 Large steps forward (and if possible backwards) with large amplitude arm swing
2. Sidestep walking	2 laps		 Large steps sideways with large amplitude arm swing. Arms abduct up during step and adduct down when taking step in.

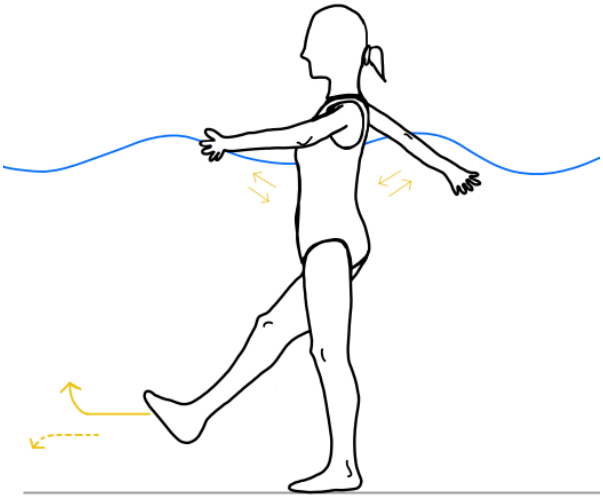
3. Marching	2 laps		 Bring flexed knee up high with large arm swing, step down and repeat with other leg.
Lower and Upper Extremity **Add resistance with paddles or arm weights**			
1. Lunge step forward and hold for 10 seconds	1-2 x 10		 Similar to the beginning of the marching step, then continue to step out and swing arms in large motion up to 90 degrees, hold for 10 seconds and swing arms down to side while stepping back. Focus on core control during step back

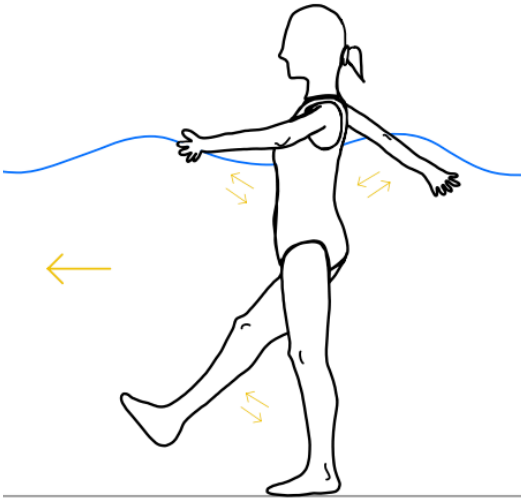
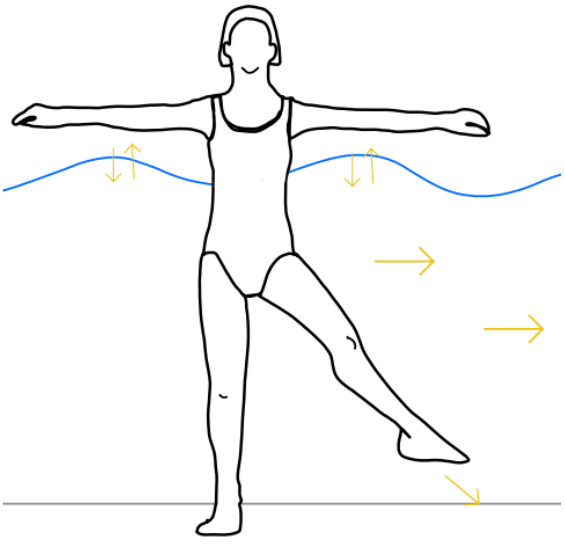
2. Side Steps, open arms out, and hold for 10 seconds	1-2 x 10		 Like the step forward and lunge, this is a sidestep, lunge and hold. Arms swing up, shoulders stay down, and engage in the core muscles. When stepping back in, continue to tighten core and glute muscles for balance and postural control while arms swing down by side.
3. Large Back Step and hold for 10 seconds	1-2 x 10		 Same as the two previous step and hold, this is a step back, with arms swinging down and back. Chest flexes towards the water and hold this position for 10 seconds. Once stepping back in, arms swing down and to the side while engaging core and tightening glutes when standing upright.

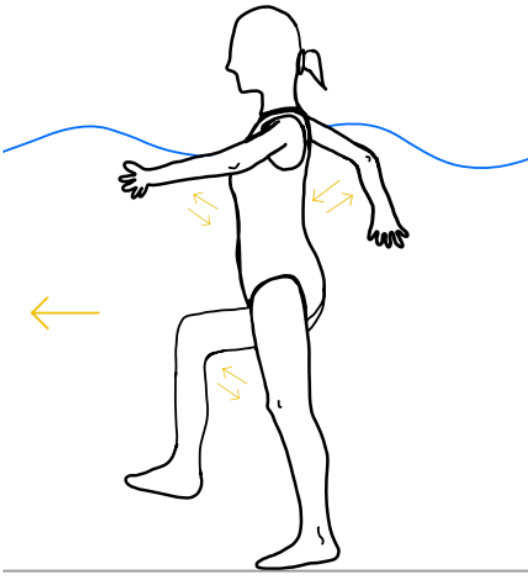
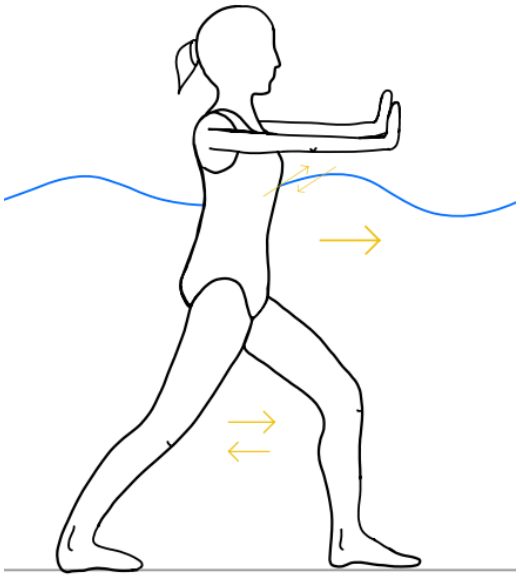
4. Chest Fly	1-2 x 10	Use wall if needed, if not complete without wall	 Similar to the single arm swing, this is now with both arms. Standing straight up, legs hip with apart (closer together to increase challenge), engage in core, arm/elbow by side and rotate forearm out to engage in shoulder external rotation then shoulder internal rotation. To adjust or complete on second round, keep arms straight and swing arms open to side. To grade up, use weights, resistance paddles, or adjust resistance paddles.
5. Twist and reach	1-2 x 10	Upgrade to a boxing punch	 Same as trunk rotations in previous week, now rotate and twist trunk while reaching arms out. Upgrade to full punch, with or without weights for this week. Focus on balance and engaging core muscles, and large explosion during punch.

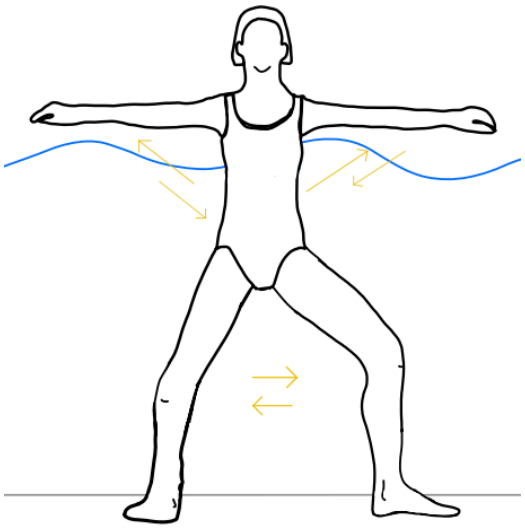
6. Shoulder retraction	1-2 x 10		 Arms straight and forward, shoulder protract and retract (push forward and pull back to make “mountain” with shoulder blades. Or hold with shoulders retracted on beach ball for stretch to open chest (deep breaths)
7. Noodle Float and leg kicks (back decompression hang pre and post kick)	1-2 x 10		

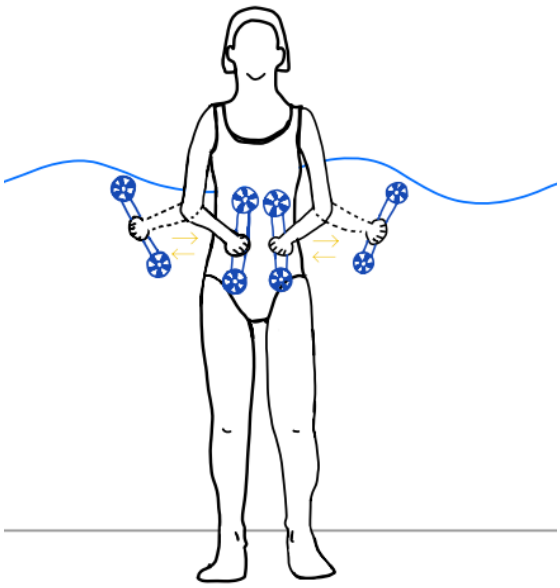
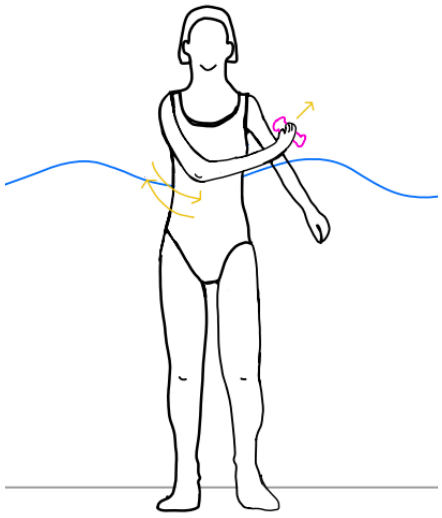
			and  Floating like the spinal decompression, now engage legs in abduction/adduction and flexion/extension to create starfish and skier like movements. Engaging in the core muscles will help keep the body steady as the lower extremities move and not float up.

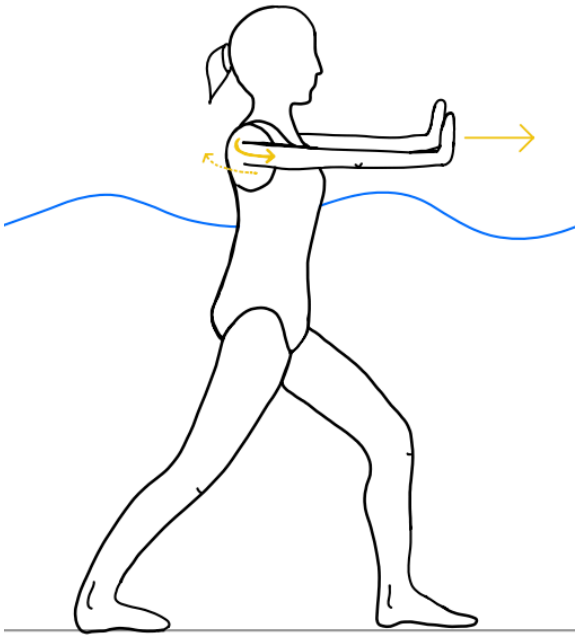
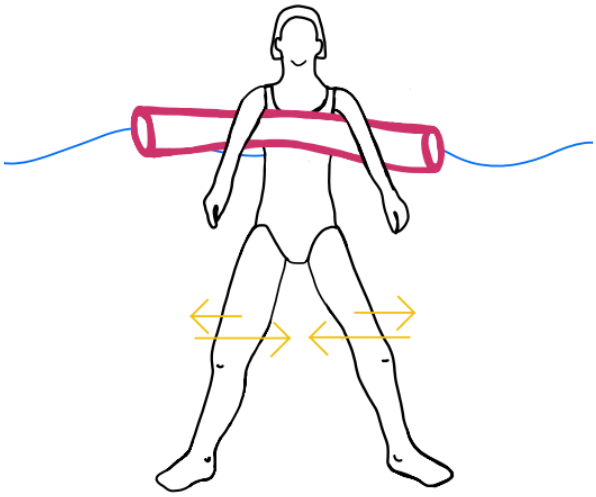
8. Ski Walking (legs go out and then forward in large movement)	1-2 x 10	Use hula hoop as external cue if needed	 Just like walking, however the step is going to swing outwards like ice skating or skiing. Ensure large arm swings during walking.
Balancing			
1. Tandem Stance	10 seconds per side or more if possible	Upgrade to close eyes	Put both feet together in a straight line, with the toes of one foot nearly touching the heel of the other. Make sure the toes are pointing forward and that the feet are not spread out. Hold this position for as long as possible.
2. Single Leg Stance	10 seconds per side or more if possible	Upgrade to close eyes	Stand unassisted on one leg, attempt to hold this position as long as possible. Engage in core muscles and do not wrap leg around standing leg.
Functional Task Activity			
1. Steps to practice on stairs	1-2 x 10		Taking step up onto one step in the pool, or to use a step training step up in pool. Like marching activity, lift flexed knee up and onto step, and step other foot up, then same for stepping down. Focus is on core control, engaging in leg and glute muscles to help with balance.
2. Self-Motivating Activity	1-2 x 10		Participant chooses activity they need/want to work on that goes towards an occupation

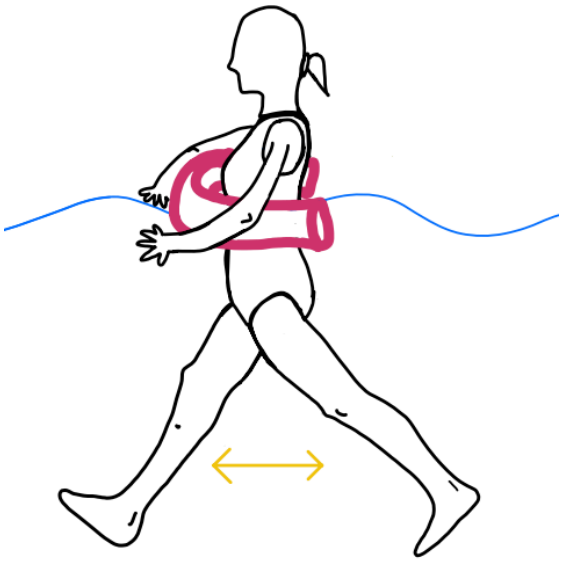
Day 8	Set and Repetitions	Grade up or down depending on level of ability	Picture and Notes
Warm Up – weights on ankles and arms (for postural stability)			
1. Forward/Backward walking	2 laps		 Large steps forward (and if possible backwards) with large amplitude arm swing
2. Sidestep walking	2 laps		 Large steps sideways with large amplitude arm swing. Arms abduct up during step and adduct down when taking step in.

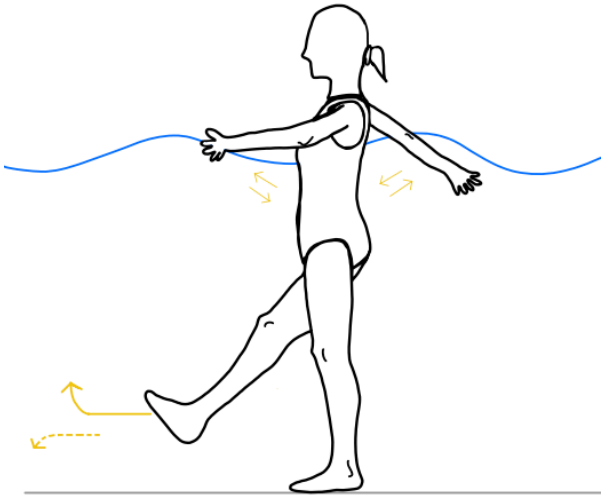
3. Marching	2 laps		 Bring flexed knee up high with large arm swing, step down and repeat with other leg.
Lower and Upper Extremity **Add resistance with paddles or arm weights**			
1. Lunge step forward and hold for 10 seconds	1-2 x 10		 Similar to the beginning of the marching step, then continue to step out and swing arms in large motion up to 90 degrees, hold for 10 seconds and swing arms down to side while stepping back. Focus on core control during step back

2. Side Steps, open arms out, and hold for 10 seconds	1-2 x 10		 Like the step forward and lunge, this is a sidestep, lunge and hold. Arms swing up, shoulders stay down, and engage in the core muscles. When stepping back in, continue to tighten core and glute muscles for balance and postural control while arms swing down by side.
3. Large Back Step and hold for 10 seconds	1-2 x 10		 Same as the two previous step and hold, this is a step back, with arms swinging down and back. Chest flexes towards the water and hold this position for 10 seconds. Once stepping back in, arms swing down and to the side while engaging core and tightening glutes when standing upright.

4. Chest Fly	1-2 x 10	Use wall if needed, if not complete without wall. Focus on core control	 Similar to the single arm swing, this is now with both arms. Standing straight up, legs hip with apart (closer together to increase challenge), engage in core, arm/elbow by side and rotate forearm out to engage in shoulder external rotation then shoulder internal rotation. To adjust or complete on second round, keep arms straight and swing arms open to side. To grade up, use weights, resistance paddles, or adjust resistance paddles.
5. Twist and reach	1-2 x 10	Upgrade to a boxing punch with resistance bells or weighted ball, then upgrade to punches as well	 Same as trunk rotations in previous week, now rotate and twist trunk while reaching arms out. Upgrade to full punch. Focus on balance and engaging core muscles, and large explosion during punch.

6. Shoulder retraction hold on beach ball for stretch to open chest (deep breaths)	1-2 x 10		 Arms straight and forward, shoulder protract and retract (push forward and pull back to make "mountain" with shoulder blades. Or hold with shoulders retracted on beach ball for stretch to open chest (deep breaths)
7. Noodle Float and leg kicks (back decompression hang pre and post kick)	1-2 x 10		

			and  Floating like the spinal decompression, now engage legs in abduction/adduction and flexion/extension to create starfish and skier like movements. Engaging in the core muscles will help keep the body steady as the lower extremities move and not float up.

8. Ski Walking (legs go out and then forward in large movement)	1-2 x 10	Use hula hoop as external cue	 Just like walking, however the step is going to swing outwards like ice skating or skiing. Ensure large arm swings during walking.
Balance			
1. Tandem Stance	10 seconds per side or more if possible	Upgrade to close eyes	Put both feet together in a straight line, with the toes of one foot nearly touching the heel of the other. Make sure the toes are pointing forward and that the feet are not spread out. Hold this position for as long as possible.
2. Single Leg Stance	10 seconds per side or more if possible	Upgrade to close eyes	Stand unassisted on one leg, attempt to hold this position as long as possible. Engage in core muscles and do not wrap leg around standing leg.
Functional Task Activity			
1. Steps to practice on stairs	1-2 x 10		Taking step up onto one step in the pool, or to use a step training step up in pool. Like marching activity, lift flexed knee up and onto step, and step other foot up, then same for stepping down. Focus is on core control, engaging in leg and glute muscles to help with balance.
2. Self-Motivating Activity	1-2 x 10		Participant chooses activity they need/want to work on that goes towards an occupation

Appendix I

Rationale behind Aquatic-based large-amplitude exercise movements

All of the aquatic exercise movements were related to how someone can perform their occupations (or daily activities) while increasing postural stability due to engaging the core muscles. The importance of breaking down the movements and creating large amplitude movements in the water is to make these movements when completing occupation easier on the participant. What is known from research is that exercise in the water helps increase strength and balance so someone with PD is able to a more independent life, in turn, will create a better quality of life for that person. The profession of OT focuses on a person's quality of life and how that carries over into their physical, mental, and emotional wellbeing. These exercises were hoped to help someone with PD feel accomplished when competing tasks outside of the water.

A good warm up is important ensure the body is encouraging blood flow to the muscles and helps prevent injuries. About a 5-10-minute warm up will be sufficient as the warm water helps increase this blood flow and will help the participant be able to complete exercises through a full range of motion. The heated water helps relax muscles that may become spastic or help with joint rigidity.

Depending on the ability of the participant, moving to more shallow water or deeper water can increase or decrease balance and water resistance. If the participant is completing the upper and lower exercises well in chest deep water, they can move to more shallow water as it increases gravity and makes the movements more challenging. If the participant is having a harder time completing these movements, going slightly into deeper water, with their head above water, will make the movements easier. Adding resistance paddles/bells and weights will also increase challenge providing the participant to use more core muscles to stay balanced and

increase strength in upper and lower extremities. Each of the movements will help core strength to ensure postural stability and balance when completing activities in the home or out in the community such as walking around the home or grocery store; reaching to grab higher items in the cabinets; sit to stands from the toilet, bed, or couch; and learning to move self out of a freezing episode.

The stretching or balance activities will help work on that postural control and cool down after the exercises. People with PD tend to have and increase in falls; and to help work on different prolonged stretches and balancing activities will make completing daily life easier. Lastly, working on a functional task to incorporate real life simulations of occupations will increase confidence when completing these movements outside of the water. The focus was to work with stairs, since the pools have stairs in the shallow end, this is something people encounter every day. Making sure the participant is taking a large step up to increase quadricep strength to take that step up and not trip is crucial for people with PD. Stairs or steps, even if they are not in their own home, to get out into the community and feel safe, it is important to increase strength, balance, and confidence in the water before moving to out of the water. Lastly, having one functional task the participant chooses as this provides meaning to the program and to their quality of life. This may be something like taking clothes out of the laundry, grabbing items in the grocery store, holding grocery bags, twisting and reaching for medications, etc. By having a meaningful activity of their choice to complete during all four weeks will also demonstrate how they perceive they are doing these tasks in and out of the water from pre and post program.

Appendix J

Protocol for Verbal Cues

I. Demonstrate movements (exercises) to participant.

II. Have participant trial movements (exercises) when you say “go”.

III. If movement (exercises) are done correctly, have participant continue the set.

IV. If movement needs to be adjusted, verbal cue what needs to be done (i.e. tighten stomach muscles, engage your core, squeeze the tummy and butt, etc. to increase postural control). Grade down to laymen’s terms if “tighten stomach muscles” or “engage your core” is not effective in postural adjustment during movements.

V. If verbal cue helps participant adjust movement, then continue.

VI. If verbal cue does not correct to increase postural control, demonstrate movement one more time.

VII. If further cueing, use a visual cue with hand motion, and increase to tactile cue if needed.

Appendix K

Protocol for Large Amplitude Movements

I. Verbal cue to make the movement larger (do not use words such as “Big” or “Power” due to verbiage for LSVT BIG and PWR!).

II. If there needs to be an additional verbal cue, use the phrase “try to explode during the movement”.

III. If there needs to be another cue, complete the first two verbal cues above and demonstrate the movement again.

IV. If there needs to be more assistance, then add on a tactile cue and visual cue of where body should be reaching end points of the movements.

Appendix L

Physiological Status of Participant

Physiological Status (Vitals) Prior To Entering Pool

Day 1	BP: 157/85 HR: 72 O2: 94
Day 2	BP: 149/77 HR: 70 O2: 99
Day 3	BP: 139/85 HR: 76 O2: 99
Day 4	BP: 154/86 HR: 83 O2: 99
Day 5	Missed Session
Day 6	BP: 148/84 HR: 76 O2: 99
Day 7	BP: 131/71 HR: 88 O2: 99
Day 8	BP: 155/74 HR: 76 O2: 97

Appendix M

Program Performance Details

Observational Experiences

The doctoral capstone student was able to gain other opportunities from different neurological therapy clinics to observe and speak with OT and PT practitioners to increase her knowledge on practice methods when working with individuals with PD. During weeks three and four of her capstone experience she observed two different OT practitioners at a neuro specialized clinic in Torrance, CA, Re+Active Physical Therapy. They had an office in Torrance and West Los Angeles to help empower people with neurological and complex health conditions to restore confidence, mind/body connections, and vitality to help people control their symptoms and live their life (Re+Active, 2023). They have a variety of wellness programs along with their therapy sessions. Their intergraded health care team works together to treat the whole person through the coordination of care, fitness and yoga, lifestyle medicine, psychology, OT and PT (Re+Active, 2023).

The doctoral capstone student was able to participate in the OT sessions and some PD wellness programs, such as boxing and PWR! Moves classes. They had different intensive programs designed for specific diagnoses of which Brigitte was able to see sessions of. This included their PD program, functional neurological disorder (FND) program, concussion program, stroke program, and some virtual sessions of lifestyle OT with Ehlers-Danlos syndromes (EDS), autism spectrum disorder (ASD), and ALS. Compared to what Brigitte had experienced in her past fieldwork rotations focusing more on physical dysfunction rehabilitation; Re-Active takes another approach when it comes to OT services in regard to lifestyle methods and models. This clarified how a diagnosis can affect someone's quality of life and ways to

enhance and learn more about themselves/diagnosis. Since quality of life tied into her capstone research, this was a tool to potentially use in conjunction with the physical exercise program to further create a better sense of quality of life with people diagnosed with PD, early and late stages. Handouts used at Re+Active included energy management, healthy mind platter, calming/alerting sensory chart, sleep 101, stress management, meditation such as RAIN and deep breathing strategies (i.e., three-part breath, diaphragmatic breathing, hand tracing, and blowing bubbles). She was able to participate in one of the virtual boxing wellness classes for PD which included a warmup, sequencing of boxing moves (standing or seated), a cool down, and stretching. Since this wellness class was run by an OT, she was able to monitor people's movements through their body mechanics and help make adjustments safely through the online platform. Since the OT is certified in PWR! Moves, she was able to incorporate this to increase larger movements from her participants in the class. Creating repetitive movements with increased sequencing was beneficial for the participants while singing along to the songs to increase dual tasking.

From the knowledge and education of the OT practitioners at Re+Active, they were able to confirm that the aquatic program created could have benefits as this was a great alternative form of exercise. After the advice, adjustments, and maintaining an occupation-based approach to therapy, the program was ready to be trialed on patients of Hands On Rehab and Aquatics to ensure feasibility on a non PD diagnosis.

After the completion of Brigitte's program, she was able to travel to Northern California to shadow an OT practitioner at Stanford Healthcare in their neurological outpatient clinic. This clinic has three OT practitioners, two SLPs, and seven PT practitioners. The clinic used leading-edge equipment and evidence-based treatment techniques to provide care for their clients. The

OT team saw a variety of neurological diagnoses and focused mainly on interventions dealing with function in daily life through ADLs, including dysphagia/self-feeding; upper extremity function and neuromuscular re-education; spasticity management, adaptive devices (splinting, FES, wheelchairs, and adaptive equipment), energy conservation/work simplification, driving simulation training, and visual-perceptual and functional cognitive screening/training (Stanford Healthcare, 2023). The whole therapy department had completed research clinical trials recently on TBI and CVA.

The week was filled with evaluations and treatment sessions, a few which presented with parkinsonism features, such as tremors, rigidity, weakness and shuffling of gait. It was helpful for Brigitte to see how the OT practitioner recommended similar exercises for the home exercise plan that she had completed in her program in the water. It demonstrated that creating large amplitude movements for symptoms similar to PD would be beneficial for a variety of diagnoses, especially when presenting with similar symptoms of PD, without the diagnosis of PD. The handouts for exercises were sent through their portal; Stanford used a subscription of Physiotec for the clients to see an explanation and video of how to complete the movements. This made it simple for people to use and continue their exercises they learned in therapy. She got to see a driving evaluation with visual simulation games to see the risk for driving on the road, then was able to see a driving simulation with reaction time and speed test. This is something that could have been simulated in the water with reaction time if a participant wanted to work on driving as their functional task training portion. The OT practitioner educated each client on the importance of listening to one's body when needing rest, which went well with what Brigitte noted to her participant in her study to ensure energy conservation. Having this opportunity to speak to the OT practitioner about the program and the compliments received on

how this aquatic program could help many people was great to hear and demonstrated the need for more research in the field of aquatics.

Impact on the Participant

Week 1

Participant #1 was able to complete the TUG and PDQ-39 prior to entering the pool. Participant #1 was walking with her cane and had to sit to put on grip socks prior to entering the pool and had minor tremors in right leg. She reported that her right leg receives the most tremors and where she noticed when her PD first occurred. Due to current knee injury, participant #1 was able to slowly get into the pool using stairs and handrails. Once in the pool she was able to complete all of Day 1 warm up and exercises. Cues were provided to increase core activation and engage/or maintain larger movements during all of the exercises. See Appendix J and K for cueing protocol. She reported no pain during movements and was able to complete all activities; however, the stairs functional activity at the end was too challenging due to her knee injury and the height of the steps, this was then taken out and substituted in her program. To grade down, she was able to use a noodle to float to decompress her back and do marching movements while hanging.

Her functional activity she chose to complete for the entire program was a simulation of carrying groceries from her car to the kitchen and placing them on the counter. Using two plastic baskets with slits to increase challenge and resistance in the water, and place two-pound weights in each basket as she carried and walked approximately 50 feet to then place the baskets on the side of the pool. She was able to increase three pounds to a total of five pounds in each basket. She completed three rounds of this activity. Post session, participant reported how surprised she was by her ability to complete all the exercises, minus the stairs, and that she felt great with no

pain. She also reported she can feel that she was fatigued by the end of the session but knows her endurance will increase.

The second session for week one, went more smoothly. Participant #1 was able to complete the movements more smoothly, demonstrated increased carryover, and was able to challenge herself more by keeping two-pound weights on her arms while completing all the movements. She was able to adjust the water paddles to increase resistance during the upper extremity exercises to increase challenge. She reported there was less discomfort in her knees and hips from the previous session, and when engaging her core muscles, it was observed that she was completing the movements with more stability and control. Less cuing was required during this session to tighten her core to control her movements; therefore, demonstrating that she was able to self-direct when aware. The only cuing was to increase her movements to make them larger, specifically during the walking and marching warm up. The exercises to push and hold went easier this time, and participant #1 wanted to include a technique she had learned in her OT sessions at UCI health. She was able to include PWR! Hands during her holds to practice opening and closing her hands from a fist while she would count to 10. She reported this helped her concentrate while completing the movements. At the end of the session, she reported she felt like this class was easier than the previous one, and that she can feel it has been a good exercise.

The doctoral capstone student provided education to the patient on information pertaining to the following weeks increasing in challenge of movements that will incorporate postural control to improve her balance. Participant #1 reported she was thankful as she has been having an increase in fear of falling the last few months and learning to control her movements would help her feel steadier and increase strength and practice on how to catch herself out of a fall. Following up on if she has had any recent falls, participant #1 reported she almost fell the night

before after getting out of bed, as she was not steady on her feet. The doctoral capstone student educated the participant on while sitting in bed and before the sit to stand, to do some seated marches, as a preparatory movement, like done in the water, to "wake up the legs" before standing and to engage her core to increase her stability once standing. The major concept of this aquatic program is to help people feel comfortable to find modifications to implement in their daily life outside of the water. This example of what participant #1 was feeling was how she could try and implement some practices she learned in the water to outside of the water.

Week 2

Participant #1 reported that the weekend went well, and she felt stronger due to the exercises in the pool. For this week she was able to increase weight and resistance with the movements and had more momentum to complete each exercise smoothly. The first session of the week, she reported she was pushing herself more; however, staying safe. She was able to increase her weight on her grocery bag activity to 5 pounds in the basket with 2 pounds on each arm and reported that this activity has already made it easier to carry groceries into the house from the car. She also reported that practicing the marching before standing up after a long period of sitting or lying down has helped her feel more balanced and she has widened her base of support during these stands to feel stable. To challenge her more during the exercises, the doctoral capstone student narrowed her base of support during the upper and lower body exercises. This demonstrated more of a challenge to stay balanced and required participant #1 to engage her core muscles to increase her postural control. The noodle float exercises of ski kicks (float with noodle and flex and extend legs forward and back) and starfish (float with noodle and abduct and adduct legs) was challenging to keep her legs from floating up due to the buoyance of her body in the water; however, when engaging in her core and tightening her glute muscles, she

was able to keep her legs pointed towards the ground. See Appendix H for program details. She was able to increase her ability to complete the grocery bag activity, not only by increasing weight, but increasing the number of trials from four (week one) to five (week two). Post session, participant #1 reported she felt great, and this session she pushed herself and knows she needs more rest. Education was provided on proper water intake, electrolytes, and nutrition post session.

The second session of the week started off well; however, due to her diabetes, after the warmup she felt dizzy. Following proper protocols, she sat down, drank her cranberry juice, and the site mentor was able to bring her diabetes glucose monitor and some candy to increase her blood sugar. After waiting approximately 15 minutes her blood sugar increased. Doctoral capstone student asked if she needed to end the session, and participant #1 reported she wanted to keep going, but decrease the weights on her arms. She was able to complete the rest of the session with no other blood sugar decreases and reported feeling great after the candy increased her blood sugar levels. Education on proper nutrition before coming for the aquatic exercise was given and participant #1 was receptive to information and reported she was glad she was able to complete the session because she has felt changes in how she feels. She reported how from this week she feels sore in her abdominal muscles but is not bad and she is feeling more stable.

Week 3

Participant #1 called out on the first session of the week due to a migraine and that she will be there on Thursday for the session. The doctoral OT student educated that it is important to take care of your body and to keep hydrated with good nutrition for the day.

The second session of the week, participant #1 demonstrated an increase in balance during the movements and a decrease in pain from her knee injuries. She reported she has been

using techniques taught to her from the aquatic program and it has been assisting her in her daily life. She reported she was feeling happier and grateful for the opportunity to participate in this program. She reported that family and friends have noticed a huge change in her mood, her balance, and her gait. She reported that they said she looked more balanced, had a smoother walking pattern and bigger arm swings during gait. Participant #1 reported that it has been significantly easier to carry grocery bags and while carrying them she feels steadier on her feet and stronger with how many bags she can carry. During the session she was able to increase the number of times with the grocery bag activity from five to six times. She has reported that her back has had an increase in pain, but nothing to do with the program or the exercises, that this is strictly an orthopedic issue, and when completing the noodle hang/floats in the deep end of the pool, this gave great relief to decompress the spine.

Week 4

The first session of the week went very well. Participant #1 demonstrated an increase in balance, postural control, and larger movements during all the exercises. She was able to produce a better flow of during the movements, self-correct without the doctoral capstone student providing verbal cues and was able to increase in resistance and strength during the upper extremity movements. She reported she had a bad weekend and was very fatigued by Sunday. During the week before, there was education and a conversation on activity pacing and the importance to preserving energy during and after more intense activities. She reported she did not take breaks like she planned to on Friday and at dinner time, had her first freezing episode from the PD. She was eating soup and was not able to get out of the position of bringing the spoon to the mouth. She reported her and her husband were shocked and scared, as this was the first time this has happened. The doctoral OT student educated on techniques of how to get out

of a freezing episode and examples she had heard with previous clients she had seen. Participant #1 reported that deep breathing and for future to try to sing/dance her favorite song to break the freeze cycle. Education on the amount of energy expended on that Friday could have contributed to the freeze, and how to manage activities with designated breaks. Participant #1 agreed and was going to plan out her days more to continue to increase postural control and functional mobility during the activities she does during the day but plan out 10–15-minute breaks to decrease the amount of fatigue she may receive from the activities. An example discussed was to schedule 15 minutes of gardening during the day, and once her bucket is filled or the 15 minutes are completed, she will stop the activity and will take a small break before going to another task to do for the day. Being able to use the knowledge and techniques learned from this aquatic program will help increase her endurance and ability to complete daily tasks while learning to incorporate rest breaks to activity pace.

The last day of the program, participant #1 came earlier to complete the post program assessments of the TUG and PDQ-39. She came in walking with her cane and reported that Tuesday's program made her very fatigued, and the cane was for safety due to feeling weaker. She started with the TUG and used the cane for the assessment, she was able to decrease her time from the first assessment day. From observation, instantly she was steadier on her feet, had a bigger arm swing with the upper extremity not using the cane; however, the cane was barely used during this measurement. Due to the minimal use of the cane, she reported she felt comfortable to try this again without the cane when asked. The second round of the TUG was without the cane, and she demonstrated a normal functional mobility ambulation pattern. Her turn around the cone was smoother, a better arm swing with both arms, and observed to be steady on her feet. The second time the TUG scores decreased even more. This demonstrated

that she was able to complete this assessment better without the assistive device and her timing showed during this second round. When completing the PDQ-39, she reported at the end that even if her scores were similar (see data analysis for final results), that this program had made her feel more confident, her quality of life had increased, she loved what the water had done for her being able to do movements she did not think were possible, and she can do so much more at home outside of the water than before.

She was able to answer an exit interview on how she liked or disliked this program. She reported, “I think my balance has increased and I am so much happier, I have noticed my demeaner is happier and my husband and friends have noticed that too. I am feeling confident in what I can and cannot do with movements and in life. My mood has increased in a good way, and I would ten thousand percent recommend this program to people” (Participant #1, personal communication, March 9, 2023). When asked if she enjoyed this program, she responded with yes. To finish the last session, she demonstrated larger amplitude during the warmup and first few movements; however, she reported she was feeling nauseous. Due to pool safety protocol, she sat down for a few minutes, she wanted to try a few more exercises, and attempted, but then she reported she needed to sit again. Due to feeling nauseous, the session was ended 20 minutes early. Once out of the pool she checked her blood sugar and it had started to decrease, which meant she needed to get some sugar in her system to increase her blood sugar secondary to her diabetes. She received the gift card for completing the program and reported she hopes this program can continue, and for her to continue to get aquatic therapy with Hands On Rehab and Aquatics as she enjoyed this whole process. She reported that her orthopedic doctor who she had seen a few days before reported that she was looking great with her knee injury and that she can get a referral to continue receiving aquatic therapy. Participant #1 was hopeful and continued to

hope that the aquatic therapy will continue to assist with her orthopedic issues (back and knees) but continue to utilize the techniques she had learned from this program to work on limitations she has had due to her PD.

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CURRICULUM VITAE

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OCCUPATIONAL THERAPY DEGREE	Occupational Therapy Doctorate (OTD) Program Length – 3 years Program starting and ending time – June 2020 to May 2023 Degree Conferred Date – (May 12, 2023) University of Nevada, Las Vegas. School of Integrated Sciences, Las Vegas, NV, USA.

OCCUPATIONAL THERAPY EXPERIENCE

May 2021 – August 2021	Fieldwork IIA – Reno, NV Saint Mary's Regional Medical Center Brittany Jemmoua, OTR/L Phone – 941-545-8343 Email – Brittany.jemmoua@gmail.com Duties – Provided occupational therapy evaluation, treatment, and discharge for patients the acute care setting
May 2022 – August 2022	Fieldwork IIB – Las Vegas, NV Dignity Health Physical Therapy Outpatient Neuro Allison Moore, OTR/L, Megan DeMott OTR/L Phone – 515-779-6433, 614-937-9897 Email – moore.allison14@gmail.com, meganlynndemott@gmail.com Duties – Provided occupational therapy evaluation, treatment, and discharge for patients with neurological conditions
January 2023 – April 2023	Capstone Experience, Huntington Beach, CA Hands on Rehab and Aquatics Greg Moe, PT, DPT, NASM, CPT Phone – 949-413-7366 Email – gregmoe@gmail.com Duties – Developed/implemented an aquatic-based occupational therapy exercise program for people with Parkinson's disease

PUBLICATIONS/PRESENTATION/RESEARCH

April 2023	"The Feasibility of a Large-Amplitude Aquatic-Based Exercise Occupational Therapy Program for Individuals With Early Parkinson's Disease" – University of Nevada, Las Vegas

PROFESSIONAL MEMBERSHIP

2020 – present	American Occupational Therapy Association (AOTA)
2020 – present	Nevada Occupational Therapy Association (NOTA)