EFFECT OF PARTICIPATION IN SHALLOW-WATER MOVEMENT THROUGH THE USE OF A STATIONARY POLE ON PAIN AND WELL-BEING OF OLDER ADULT WOMEN WITH KNEE AND OR HIP OSTEOARTHRITIS

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“Aquatic exercise and swimming…no sweat!”– M.V. Saunders

This dissertation is dedicated to the memory of my mother and father Mary Jacqueline and Paul Bentz, Saunders and my nephew Michael Andrew Saunders, their example of loving understanding encouraged me to accomplish anything I set my mind to do.

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Globally, osteoarthritis (OA) is projected to be widespread among older adults; the most profoundly affected joints are the spine, hip, and knee (A. Fisken, Keogh, Hing, & Waters, 2015). Studies in epidemiology have indicated that OA is responsible for more disability, sick days off, difficulty climbing stairways, and walking than all other conditions related to musculoskeletal ailments (E. M. Bartels, Juhl, C.B., Christensen, R., Hagen, K. B., Danneskiold-Samsoe, B., Dagfinrud, H., Lund, H. , 2016). The symptoms most salient are: pain, muscle weakness, diminished function, and reduced well-being (Lu et al., 2015). In consideration of the enormity of the physical and psychological impact that OA has on persons who are affected by OA of the knee or hip, and the financial burden that it exerts on health care systems around the world, as well as the individual, cost effective nonpharmacological interventions such as shallow-water functional movement, may help to alleviate this growing and serious public health issue.

The purpose of this study was to determine if there is a difference in participant perceived pain and well-being of older adult women with knee and or hip OA engaged in an aquatic functional movement intervention without the use of a stationary pole compared with engagement in the same aquatic intervention with the use of a stationary pole. The conceptual framework for the study was grounded in self-efficacy theory, and the selection, optimization, and compensation model of aging well. The study used a replicated and randomized single-case two-condition crossover design to collect data. Data were collected through repeated pain

measures, pre and post treatment measures, and retrospective pretest and posttest measures. Pain data were entered into the Microsoft Excel® ExPRT 2.0 single-case AB design program to generate graphs and pre-crossover and post-crossover phase means. Visual analysis of graphs and descriptive mean pain data, showed no convincing difference between the two conditions. This finding was confirmed with follow up sensitivity analysis with a mixed model for repeated measures linear regression using SAS® 9.4 software, and a paired t-test using Microsoft Excel 2013. For well-being, physical function, general self-efficacy, and pain self-efficacy, graphs were generated with Excel 2013 on pretest and posttest primary data. Comparison of individual score means and visual analysis of graphed scores, indicated a positive effect of the intervention, except some findings were contradictory, in particular for self-efficacy. For the recreational or aquatic therapist, and the individual, results from the pain data indicate use of a stationary pole may not be any more effective on perception of pain than the movement program itself; this may translate to cost savings. In addition, the study preliminarily found a positive correlation between the intervention and pain, well-being, and physical function that further investigation using a larger sample for a longer duration, is recommended.

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CHAPTER I

INTRODUCTION

The symptoms related to osteoarthritis (OA) have been characterized as having varying levels of inflammation, tenderness, limited motion, crepitus, and pain (E. M. Bartels, Juhl, C.B., Christensen, R., Hagen, K. B., Danneskiold-Samsoe, B., Dagfinrud, H., Lund, H. , 2016). To date there is no cure (Waller, 2014), there are however, available treatments and preventative therapies to address the symptoms to lessen the progression of the condition. OA of the hip and knee are the most prevalent conditions, affecting as much as six percent of the overall world population of people over age 30. The probability of the onset of OA normally increases as one get older, as the population of older adults grows, the incidence of OA will most likely grow as well (Bartels, et al., 2016). In a 2015 United Nations report, an older adult is identified as someone who is over 60 years of age (*World population ageing 2015*, 2015).

The identification and promotion of strategies to effectively manage conditions related to OA have been marked as a high priority for public health agencies. Mounting empirical evidence indicates that aquatic functional movement/exercise may help diminish the hardship associated with the symptoms related to musculoskeletal disease. This is due to the property of buoyancy provided by the immersion of one's body in water, diminishing the stress and compression on weight bearing joints and lessening the effect of gravity, allowing movement that improves range of motion and strength. In addition, exercise of greater intensity can be performed in an aquatic environment with less stress to the cardiovascular system than on land (Bartels et al., 2016). Management of OA is focused either on pharmacological treatments such as surgery, anti-inflammatory medications, and over the counter analgesics; or nonpharmacological treatments like education, exercise, weight loss, and physical therapy. At

present, the recommended nonpharmacological approaches to manage symptoms related to OA, are thought to have the best effect through weight loss and exercise. The strategies of land centered cardiorespiratory group movement combined with strengthening, or aquatic therapeutic exercise, are acknowledged as crucial elements for the accomplishment of these recommendations (Waller, 2014). For individuals who have OA of the knee and or hip, an aquatic functional movement intervention provided through the use of a stationary pole and grounded in self-efficacy, may be one nonpharmacological approach to help alleviate some of the adverse effects associated with OA, and help to ameliorate its burden on the individual and to humanity.

Specific Objective 1: To evaluate perceived pain of older-adult women who have hip and or knee OA while engaged with a shallow-water functional exercise with or without the use of a stationary pole. A replicated and randomized two-condition single-case crossover research design was employed to collect data. Repeated retrospective pretest and posttest measures of pain data were recorded and analyzed for descriptive statistics and graphs for visual analysis and outcome interpretation.

Specific Objective 2: To assess the perceived well-being of older-adult women who have hip and or knee OA while engaged with a shallow-water functional exercise with or without the use of a stationary pole. This was assessed with the use of the arthritis impact measurement scales 2-short form (AIMS2-SF). Retrospective pretest and posttest data were collected to provide graphs for visual analysis and comparison of retrospective pretest and posttest scores for interpretation of outcomes.

Chapter II

REVIEW OF RELATED LITERATURE

Introduction

Worldwide, by the year 2020, it is estimated that osteoarthritis (OA) will be the fourth leading origin of disability (Hurley et al., 2013). OA is a condition characterized as degenerative and chronic, it encompasses the whole joint to include the capsule (enables the joint to flex), and synovium (the inner lining of the capsules), the bone near the joint, and the articular cartilage. The articular cartilage is the tissue around the joint that provides a lubricated and smooth surface for the joint to articulate, the most detrimental changes happen with this tissue because it can be subjected to ongoing degeneration. Articular cartilage does not have any nerves or blood vessels, it is exposed to very harsh conditions, and its capacity to self-repair and heal are limited. OA is typified by pain, limitation of function, loss of range of motion, and loss of social interaction (Fox, 2009).

OA, also known as severe tangential joint pain, has become exceedingly prevalent, and is a leading source of disability and health care maintenance expenditure (Hurley et al., 2013; Lu et al., 2015). Presently, there is no recognized cure for OA (Waller, 2014). Of all the forms of arthritis, OA is projected to be the most widespread among older adults; the knee and hip being the joints that are the most significantly affected (Bennell & Hinman, 2011). The occurrence of someone experiencing symptoms related to OA of the hip during one's life is approximately 25%, whereas, OA of the knee is much greater at approximately 45% (Uthman, 2013). For individuals with OA, over time the symptoms gradually worsen, diminishing one's independence and life quality. As well, the economic cost to society is considered to be a significant burden. With people living longer, the psychological and socioeconomic ramifications of this disease

will rise, along with the consequential adoption of an inactive lifestyle that may potentially lead to obesity (Hurley et al., 2013). Knee and hip OA have been associated with pain, as well as, several physical ailments that can profoundly affect overall psychological and physical well-being (Ackerman, Page, Schoch, & Brand, 2013). Pain relief can be achieved in numerous ways through a self-efficacious coping mindset. Persons, who believe they will alleviate their suffering, will most likely assemble learned skills to mitigate their pain to continue with their intended objectives. Persons, who have doubt in their self-efficacy, will most likely readily let go of the pursuit of intended objectives, especially when the results are not immediate (Bandura, O'leary, Taylor, Gauthier, & Gossard, 1987).

Self-Efficacy Theory

One's belief in their self-efficacy will affect the character of their functioning, via processes related to their motivation, affect, cognition, and decision making. In particular, the way an individual believes in their self-efficacy can influence how their thoughts may be optimistic or pessimistic, in a way that can be either enabling or debilitating. In essence, one's belief in their self-efficacy can influence their self-motivation to persevere through challenging difficulties to attain perceived goals. This relates to an individual's belief in their ability to cope with challenging situations that can play a significant part in how they effectively self-regulate their emotional state. Self-efficacy can also affect the character of how they deal with their emotions and how vulnerable they are to being depressed, and or, stressed. Ultimately, the way that one believes in their self-efficacy can contribute to the development of the self and how one copes with change, depending upon the processing of the choices that are made. Self-efficacy beliefs influence the palette of options that one can choose from to face crucial points in their

decision making processing. Through one's choice of their environments and activities, they are setting a course along a path to who they will become (Bandura, 2012).

An individuals' level of self-efficacy has been used frequently to predict aspects of the psychological experience of, and tolerance to, pain (Koenig, Kupper, Skidmore, & Murphy, 2014). In particular, research indicates that people who have high self-efficacy, tend to rate a stimulus that causes pain as being a lot less uncomfortable than people whose self-efficacy has been determined to be lower. Research also indicates that people with high self-efficacy exhibit less pain related behavior (Koenig et al., 2014). In other words, the stronger one believes in their ability to successfully execute a desired behavior to effect an intended result, the better chance of a favorable outcome. Moreover, the amount of strength in their self-belief will determine if the person decides to initiate the desired behavior and try to cope with possible subsequent adverse repercussions; such as, perceived pain during a chosen activity (Di Pietro et al., 2014).

A person's belief in their individual efficacy makes up a substantial portion of knowing about their self (Bandura, 1997). The beliefs related to ones' self-efficacy are composed of four primary sources of information that affect efficacy knowledge. These four primary sources about the understanding of ones' self-efficacy are: (a) indications of personal capability through experiences of mastery (of the four sources, it has the greatest impact on efficacious beliefs), for example, achieving mastery of a task; (b) proxy experience, through observation and comparison of others to model their accomplishments of competency; (c) social influence (e. g. verbally persuading an individual that they possess particular abilities during performance of a task); and (d) affective and physiological conditions that an individual can use to partially assess their strengths, capabilities, and how vulnerable they are to being in a state of dysfunction. This last source of information is focused on how fear, restlessness, moods, levels of stress, and reactions

of a physical nature, can affect an individual's beliefs (Bandura, 1997; Connolly, Aitken, & Tower, 2014). All four of the sources of information are operating simultaneously, providing an influx of disparate information where individuals weigh and assess the importance of each source to then synthesize all of the information into an integrated and prioritized whole. At the same time, one has to take into account that the information can vary over dissimilar modes of human function, to then form a judgement that affects ones' self-efficacy beliefs and their choice of action. After formation of ones' self-efficacy beliefs, these beliefs can make quality contributions to the function of the individual in various fashions. This is accomplished through the enlistment of the operations of affect, motivation, cognition, and decision making (Bandura, 1997). The above processes are used by the individual to decide not to make, or make and maintain, a behavioral change.

To illustrate this point, researchers Wong, Chan, and Chair (2010), investigated the effect of an education intervention to manage pain by measuring the parameters of: restlessness, self-efficacy, and pain, in individuals who had a musculoskeletal injury and subsequent surgery. In the quasi-experimental two-group study, the control condition group continued with normal health care, whereas the intervention group continued with normal health care that included a self-efficacy centered instruction on managing pain for one-half hour per intervention session.

The results of this one-year study on the effect of an education intervention on pain management, indicated that there may be a positive effect on pain due to the treatment condition only while subjects were hospitalized after their surgery. Measures of restlessness for the intervention group were significantly diminished, the intervention had a positive effect on reduction of restlessness while subjects were hospitalized after being discharged. Level of self-efficacy showed a significant statistical difference between the two groups, $F(1,123) = 4.25$, $p =$

0.048. The intervention group produced a constant increase of perceived self-efficacy, whereas the control condition group showed a diminished perception of self-efficacy prior to surgery and 30 days post-surgery. The significant outcomes for differences of self-efficacy between the two groups indicated that subjects in the instruction group had greater levels of perceived self-efficacy for managing pain while in a hospital setting. Based on the results of the study, the researchers concluded that the education treatment condition may play a critical part in managing and coping with pain. In essence, reducing restlessness and improving perceived self-efficacy while under hospitalization, may help control pain (Wong, Chan, & Chair, 2010).

The above empirical research indicates a beneficial effect of self-efficacy based instruction on the management of pain. For the present study, instruction and implementation of the functional movement aquatic intervention may have played a role on subject self-efficacy and thus perceived pain. Within the study, in reaction to the amount of pain that subjects may have experienced while engaging with the aquatic intervention, they may have intuitively employed a strategy to help them adapt to the situation to lessen their pain. This intuitive strategy of adaptation has become known as the selection, optimization, and compensation model.

Selection, Optimization, and Compensation Model

The selection, optimization, and compensation (SOC) model refers to an individual's adaptive strategies of action that through the entire life span, supports well-being and health (Müller, Heiden, Herbig, Poppe, & Angerer, 2015). Often considered and referred to as a theory, SOC, is actually a representation of a meta-model that is used as a descriptive and explanatory system to understand and support the process of aging well and successful aging (Hawkins, 2009). The SOC model proposes that in certain situations that are characterized by a limitation

of resources combined with high demand, that people will make use of four strategies to regulate their actions that can help them to optimally make expenditures of available resources. When one employs selection, they are prioritizing which goals are more important, so as to acquire either an intended state (an elected option), or, out of a reaction to a resource loss (loss centered option), to be used in the achievement of a goal. The entailment of acquiring, refining, and use of needed resources for the achievement of chosen goals, is how one employs optimization. One uses compensation through the substitution of potential resource loss with the acquisition and use of formally unused or new resources (Moghimi, Zacher, Scheibe, & Van Yperen, 2017).

There are three elementary human developmental procedural assumptions that the SOC model is founded upon. The first assumption refers to an individual's development that is shaped through proactive and reactive responses to the external and internal environment allowing the individual to impact the level and direction of their growth, by the setting and pursuit of goals. The second assumption refers to resources in relation to one's time, energy, and social reinforcement. Throughout one's life, these resources can have limitations that require the individual to set goals that will optimize their use. The third assumption is that one's development can go in multiple directions that can lead to potential gain or loss. As well, one's development can have several purposes, where one action may address more than one purpose or function. In essence, based on the above procedural assumptions, the model asserts that the regulation of these three developmental processes are in the pursuit and setting of goals to achieve one's objectives, at the same time, manage loss of resources (Knecht & Freund, 2016).

There have been several studies that demonstrate across the lifespan of the adult, individuals who reported if they habitually and clearly delineated selected goals, made the investment in and acquisition of resources to optimally achieve their goals, that when confronted

with a loss in ability, they compensated with their remaining abilities to maintain their goals, consequently had elevated levels of emotional and psychological well-being (Knecht & Freund, 2016).

Well-Being

In a report by the European office of the World Health Organization (WHO, 2009), highlighting programs and policies important to the support for the improvement of mental health for the world population as a whole, identified mental health and well-being as crucial to overall health. The report was an exploration of mounting evidence that mental or cognitive health has an extensive range of consequences for the community, as well as, the individual. This includes better overall health; healthy lifestyles; less restriction in daily life; attainment of higher education; improved physical health and better rehabilitation; higher productivity, earnings, and employment; improved relationships with children and adults; greater social cohesiveness; and improvement in life quality. This bounty of evidence is not in the absence or consequence of mental illness, rather, they are related to the existence of a positive outlook toward mental health, recognized as a state of well-being (Friedli, 2009).

A recent study on psychological well-being compared a traditional physiotherapy intervention to a therapeutic movement exercise intervention on people with OA of the knee to determine which would be more effective. The study employed an experimental pretest posttest design that included 118 participants. All participants were diagnosed with OA of the knee and all were within the 50 to 65 years of age group. One group of 59 participants were in a traditional physiotherapy intervention (40 female and 19 male), and the other group of 59 participants were in a therapeutic movement exercise intervention (31 female and 28 male).

The outcome measures were the General Psychological Wellbeing Index (GPWBI) to test for psychological well-being and the Visual Analog Scale (VAS) to test for levels of pain. The traditional physiotherapy intervention consisted of a warm-up, range of motion, active movement, muscle strengthening, stretching of the muscles, and a cool down period. The therapeutic movement exercise intervention consisted of participants receiving isometric movement focusing on the quadriceps and the application of hot packs. Each group participated with their assigned intervention for four weeks, three sessions per week. The measurement of pain of the knee and psychological well-being were pretested during the week prior to engagement with the intervention. The same measures were used for post intervention testing.

Analysis was performed by using the standard deviations and means of collected data. Paired *t* tests were used for comparison of the pretest and posttest scores for each group. All testing was determined to be two directional with a significance of $p = 0.05$. Data were entered into the SPSS statistical program version 18 for analysis. The results of the study indicated that measures for pain were significantly improved between pretest and posttest for both groups. Comparing the traditional physiotherapy outcomes with the therapeutic movement outcomes indicated that the therapeutic movement exercise intervention helped to improve psychological well-being of the participants in the therapeutic movement group. Outcomes of effect sizes indicated that for the therapeutic movement group, the intervention helped to reduce pain and improve psychological well-being. The analysis of depression between both groups, indicated that the therapeutic movement intervention group perceived a reduction in their levels of depression more than the traditional group. It was thought that the therapeutic movement exercise intervention group experienced more of an improved level of psychological well-being

during the intervention because they experienced lower levels of anxiety, emotions related to negative stress, depression, and pain (Jebakani, Sethu, Pahinian, Tipandjan, & Devi, 2015).

Pain

The symptoms associated with OA are: pain, limited physical mobility, depression, lessened satisfaction with life, impaired life quality, and diminishment of psychological well-being. Research indicates that pain as a result of OA is a main cause of symptoms of depression and disability. Pain along with physical impairment are central factors of hardship for individuals with OA that leads to a reduction of quality of life (Jebakani et al., 2015).

Disorders related to longer term or chronic pain such as spine degeneration or injury, and adverse musculoskeletal conditions related to OA or osteoporosis, are apt to result in a reduction of well-being (Park, Hirz, Manotas, & Hooyman, 2013). For example, researcher Tse and colleagues (2012) found that there were significant positive and negative relationships between cognitive well-being and pain. The results of their study on two groups of older adults, one group with pain and one group without pain, indicated that the group without pain had scores higher on being satisfied with their lives, being happier, less depressed, and less lonely than the group with pain (Spearman's Rho $P < 0.05$). The study found that for both groups their test scores were significantly different for being depressed and lonely, with significantly greater test scores for being depressed and lonely in the group with pain (Whitney-Mann U-test, $P < 0.05$). With respect to the profound consequences of the relationship of pain on older adult cognitive and physical well-being, there is an important need for health care professionals, as well as older adults to effectively manage pain without medication (Tse, Leung, & Ho, 2012).

Nonpharmacological Intervention

In light of the enormity of the impact that OA has on people who are affected by OA, and the financial burden that it exerts on health care systems around the world, and the individual, cost effective nonpharmacological interventions may help to alleviate this growing and serious public health issue (Shrestha, Schofield, & Devkota, 2013). Because of the high incidence of the use of medications to treat pain, older adults run a higher risk of over medicating, and or, polypharmacy. This can lead to adverse drug side effects such as an increased risk of falling resulting in bone fractures, bleeding of the gastrointestinal tract, loose stools or constipation, drug overuse or abuse, drug dependency or addiction, cardiac arrest, and death. All of these adverse side-effects can have devastating consequences to one's health, such as, restricted mobility or becoming socially isolated. This increase in risk of older adults over medicating or combining medications that result in a variety of negative drug reactions, necessitates the demand for a nonpharmacological approach to the management of pain; either by itself, or in tandem with traditional pharmacological treatments. One effective nonpharmacological approach is recreational therapy (Shrestha et al., 2013).

Recreational Therapy

There exist several professions related to health care, recreational therapy (RT) is one of those professions. One definition of recreational therapy by Shank & Coyle (2002), is that RT is a planned and systematic use of recreational and activity related interventions, to form a supportive environment, intended to effect a change in an individual's beliefs, behaviors, skills, and attitudes that will necessitate a social and psychological adaptation toward well-being and health (as cited in *Recreational therapy : An introduction*, 2015). Another definition of RT is that it is the purposeful employment of goal centered treatments that engage individuals in

activity that produces leisure and recreational experiences that can lead to an individual having an optimal level of health. Both definitions have shared elements of the planned and purposeful effective use of leisure and recreation as a treatment to enhance an individual's well-being and health, resulting from the recreational therapy treatment. Other concepts and themes identified with RT include but are not limited to, are: focus on strengths and abilities, intrinsic motivation, self-determination, actualization, stability, inclusivity, and positive production of benefits to one's health as a consequence of RT practices and services (Austin, 2015).

The use of models by the practitioner within the human health services, especially therapeutic recreation and recreational therapy, have embraced and put particular emphasis on, strengths based concepts to promote and maintain overall optimal health. This approach is also shared by the International Classification of Functioning, Disability, and Health (ICF), a program within the World Health Organization (WHO). The strengths based model asserts that the cause of an alteration in functioning can be from one, or a combination of, the following three elements: difficulty with being involved in situations presented in one's life; having an abnormality in, or loss of, a bodily structure or function; and problems with carrying out an activity. Any one of these elements can be affected by factors within the context of a situation that can have either a restricting or facilitating role on behavior. To counterbalance the influence of these three elements, the strengths based model focuses on trying to identify sources of facilitation that can foster optimal health instead of the treatment and care of disease. This is accomplished through the creation and promotion of healthy conditions and favorable environments to achieve and maintain optimal health. Optimal health focused goals are centered on inclusion, participation, and performance (Wilhite, Martin, & Shank, 2016).

The following by authors Broach and Datillo (1996) illustrates the long held consensus within the research community, that aquatic therapy is a practicable intervention for recreational therapy. The application of aquatic therapy to facilitate activity in the form of exercise via swimming and other aquatic-based activities, is considered to be of benefit to physical and cognitive well-being. For people with developmental disabilities warmer temperatures, resistance, and buoyancy of water, provides a climate in which exercise is more conducive to the achievement of treatment objectives than can be accomplished on land. As well, aquatic therapy exercise can improve the function of every important muscle group, while avoiding the detrimental impact of land centered exercise. The improvement of physical abilities have been reported from studies on people with cystic fibrosis, multiple sclerosis, impairment of the musculoskeletal system, asthma, cerebral palsy, and arthritis. In addition, it has been identified that cognitive benefits to individuals while engaged with an aquatic therapy program shows improvement in mood, body-image, self-esteem, and diminishment of both depression and anxiety. Besides benefits to physical and cognitive abilities, the development and promotion of swimming and exercise through recreational aquatic therapy can result in a leisure activity lasting a lifetime that can help with health maintenance and contribute to a sense of happiness or well-being (Broach & Dattilo, 1996).

Aquatic Exercise

Exercise in the water has an extensive history of using its unique properties for health promotion; at the same time, its popularity along with other fitness programs, is experiencing a wider and growing older adult audience (Lu et al., 2015; Thompson, 2015). Buoyancy reduces gravity's effect on load bearing joints that combined with warmer temperatures of the water, can be perceived by the participant as: feeling better about oneself, reducing pain and fatigue, as well

as, providing greater enjoyment; subsequently this may translate to improved well-being (Lu et al., 2015). Aquatic exercise provides an environment that supports load bearing joints that can allow an individual to achieve physical movement that they could not otherwise accomplish on land; thus exercise in the water is an excellent mode of exercise, especially for older adults with osteoarthritis (Fisken et al., 2015).

According to a recent systematic review with meta-analysis on the effect of aquatic exercise on people who have OA of the knee, movement of the human body while immersed in water produces a resistive effect that improves endurance, muscle tone, and development of power (Lu et al., 2015). There have been numerous studies that demonstrate a favorable physiologic adaptation to a variety of water centered exercises for older adults that include improvement in balance (Arnold & Faulkner, 2010), gait (Kim & O'sullivan, 2013), and an increase in musculoskeletal strength (Wozencroft, Pfeiffer, & Milner, 2013). Studies also indicate that aquatic-based exercise compared with land centered exercise have similar outcomes on the improvement of the mobility and functionality of people with rheumatoid arthritis or OA. In addition, some research indicates that amongst older adults, exercise in water can result in higher adherence to a regimen of exercise than land centered exercise (Fisken, et al., 2015; Wang et al., 2011).

Aquatic exercise can be defined as training in an upright or vertical position, in deep or shallow water, to focus on various fitness-related areas in a low-impact environment. Engaging in shallow-water exercise can offer an appealing alternative option to land centered exercise and is becoming progressively more popular with older adults. This is because being immersed in the water can reduce the risk and fear of falling, in a comfortable and safe environment that improves mobility and health. Studies measuring the effect of shallow-water exercise, based on

functional movements related to activities of daily living (ADLs), have indicated improvement in: coordination, agility, muscular endurance and strength, flexibility of the lower and upper body, balance, walk speed, side steps, cardiorespiratory fitness and endurance, and overall well-being (M. E. Sanders, Islam, Naruse, Takeshima, & Rogers, 2016). The performance of ADLs can best be facilitated through the incorporation of the tenets of functional movement into an exercise protocol.

Functional Movement

Involvement with an exercise routine is frequently recommended for the delay and prevention of disability in our later years. Routines that include functional movement training that use similar movements to the performance of activities of daily life (ADLs), is an appropriate method to address these recommendations. It is an essential component of independent living to be able to optimally perform ADLs. If an individual has difficulty in accomplishing their ADLs, it will increase the probability of the reliance on the assistance of others and being placed in an assisted living facility, at the same time, inability to do ADLs is related to a diminishment in well-being. For example, if one cannot get out of a chair independently, they more likely be moving to an assisted care facility. Functional movement training can be of great benefit to the older adult for the improvement in the performance of their ADLs. Functional movement training tries to coordinate the muscles in purposeful patterns of movement that are multiplanar, incorporating movements that use several joints, to consistently and efficiently alter one's support base to improve function. A succinct definition of functional movement training is that the essential component to functional movement is: purpose. Thus, functional movement training is the performance of any kind of practice that is conducted for a

purpose that will enhance a particular activity or movement (Liu, C., Shiroy, D., Jones, L., & Clark, D. 2014).

As the individual ages, the motor, sensory, and central systems for processing become impaired. This process leads to the degeneration of one's bones and muscles, balance, power and strength, and a weakened neuronal transmission system. Regardless of these processes, the older adult strives for independence for as long as possible. Through the improvement of muscle power/strength, and balance, the older adult can maintain a wide array of movements to accomplish daily life activities; from walking, to getting up from a chair, to getting on and off a bus. This improvement in the aforementioned abilities, through an effective program of functional movement training, the older adult may be able to avoid, delay, and reduce the lessening of performance in physical abilities. The primary objective of functional movement training is to enhance muscle development for the achievement of a more secure, effective, and less tiring implementation of the movements used in daily life. To optimize the benefit of a functional movement training program, the movements should replicate the movements used in activities in daily living (Morat & Mechling, 2015). Because of the importance of functional movement in the ability of an older adult to maintain the performance of their ADLs, the fundamentals of functional training were incorporated into the exercise protocol for this study.

Summary

In light of the rapid growth in the incidence of adverse symptoms related to OA and mounting costs of health care, a paucity of research on the effect of water based physical movements on the knee and hip, as well as, conflicting research on its effect on pain, necessitates the need for further research. Therefore, the primary objective of this study was to test and evaluate the effectiveness of a functional movement program provided with or without the use of

a stationary pole in shallow-water that may potentially decrease symptoms of pain in older adult women with OA of the knee and or hip. The secondary objective was to examine and appraise the effect of a functional movement program with or without the provision of a stationary pole in shallow-water, on the potential enhancement of the perception of well-being and physical function in older adult women who have knee and or hip OA.

Chapter III

METHODS

The following points outline the procedures used to perform the study. The purpose of this study was to (a) determine if a shallow-water functional movement intervention has an impact on perceived pain and well-being among older adult women age 61 to 81 who had pre-existing symptoms of knee and or hip OA and (b) determine if there is a difference in participant perceived pain and well-being when engaged in an aquatic functional movement intervention provided through the use of a stationary pole compared with engagement in the same aquatic functional movement intervention without the use of a stationary pole. The conduction of this research project consisted of the following: (a) study participants (b) setting, (c) outcome instruments, (d) study procedures, (e) study design, (f) participant data, (g) data analysis, (h) results, and (i) summary.

Study Participants

Seven older adult volunteers were enrolled into the study to participate with the intervention, six women and one male. The male was asked to halt his participation with the study after the first week due to health concerns (see participant description below). A small sample of older adult women (n = 6) met the study criteria of being diagnosed with knee and or hip OA. Participants were between the ages of 61 and 81; had a mean age (M = 67.67) years, body mass index (BMI) of (M = 26.37), and mean height (M = 65) inches. All participants resided within the same small Midwestern community, and had at least some college or went on to finish their undergraduate or graduate degrees. The following descriptions of the participants were gleaned from their answers to the PAR-Q+ health questionnaire and the demographic questionnaire. Mock names were used for all participants.

Mrs. Messina. Is a married sixty-one year old Caucasian woman, who has had OA of the knee and hip for approximately one and a half years. Mrs. Messina reported that she has a bone or joint condition that may be exacerbated by a change in physical activity. This may be because she reported that some of her current activity can be limited, due to pain in her left hip and left knee. However, Mrs. Messina reported that she is physically active and exercises regularly; on a typical day, she can feel slightly fatigued. She did not take prescribed medication for her pain during the study and she is a candidate for knee replacement surgery for her left knee. In the past, Mrs. Messina has participated in aquatic exercise programs, although while in the study, she did not participate in an aquatic exercise class. She exhibited a highly cognizant awareness of current events and her surroundings. Mrs. Messina reported that she gets emotional/social support most of the time. Mrs. Messina participated at the YMCA I.

Mrs. Ulrich. Is a married sixty-one year old Caucasian woman, who has had OA of the knee and hip for approximately 23 years. She displayed a highly cognizant awareness of current events and her surroundings. She did not take prescribed medication for her pain during the study and she has not had any surgery to the lower extremity. In the past, Mrs. Ulrich had participated in aquatic exercise programs, however, she did not participate in an aquatic exercise program while in the study. Mrs. Ulrich has a bone or joint condition that can be exacerbated by a change in physical activity. She had indicated that some of her current activity, such as walking on hard surfaces too quickly, can be painful and can get worse due to intermittent inflammation. During a typical workday, she says that she does not get fatigued because she can pace herself. She reported that she rarely gets the emotional/social support that she needs. Mrs. Ulrich participated at the YMCA I.

Mrs. Calloway. Is a married eighty-one year old Caucasian woman, who has had OA of the hips for approximately seven and one-half years. She did not take prescribed medication for her pain during the study and she has not had any surgery to the lower extremity. In the past, Mrs. Calloway has not participated in an aquatic exercise program, and she did not participate in an aquatic class while participating in the study. She reported that she stays physically active doing chores, and walking around the house. She exhibited a highly cognizant awareness of current events and her surroundings. Mrs. Calloway has a bone or joint condition of the hip that can be exacerbated by a change in physical activity. She had indicated that she has a family history of high blood pressure and heart conditions. She herself, has high blood pressure, it is controlled with medication through her attending cardiologist. She also experiences some joint stiffness. She reported that she sometimes gets the emotional/social support that she needs. Mrs. Calloway participated at the YMCA I.

Mrs. Jeffers. Is a married sixty-three year old Caucasian woman, who has had OA of the knees for approximately six and one-half years. She did not take prescribed medication for her pain during the study and she has had one knee replacement surgery. In the past, Mrs. Jeffers had not participated in an aquatic exercise program and she did not participate in an aquatic class while in the study. She is regularly physically active five days a week, for at least 30 minutes each day. On a typical workday, she feels slightly fatigued. She displayed a good awareness of current events and her surroundings. Mrs. Jeffers reported that because of her knee replacement surgery, she had limited physical activity until fully recovered from the surgery. She indicated that she always gets the social/emotional support that she needs. Mrs. Jeffers participated at the YMCA II.

Ms. Pace. Is a divorced seventy year old Caucasian woman, who has had OA of the knee for approximately five years. She reported that she did not take prescribed medication for her pain during the study. Ms. Pace has moderate to high blood pressure and is taking medication to control this condition. In the past, Ms. Pace had participated in aquatic exercise programs, although she did not engage with an aquatic program during her participation in the study. She is regularly physically active seven days a week, for at least 30 minutes each day. As well, she exhibited a highly cognizant awareness of current events and her surroundings. Ms. Pace reported that she has a bone or joint problem that could be made worse through a change in physical activity. She indicated that she gets the social/emotional support that she needs most of the time. Ms. Pace participated at the YMCA II.

Mrs. Sage. Is a married seventy year old Caucasian woman, who has had OA of the knee for approximately ten years. She reported that she did not take prescribed medication for her pain during the study. Mrs. Sage had not previously participated in an aquatic exercise program but did not engage with an aquatic program while in the study. Prior to her involvement in the study, she had been regularly physically active for the past six months. Mrs. Sage reported that sometimes one of her legs can go limp and it can present a limitation on her physical movement/activity. She displayed a highly cognizant awareness of current events and her surroundings. She indicated that sometimes she gets the social/emotional support that she needs. Mrs. Sage participated at the YMCA II.

Mr. Ambercrombie. Is a married sixty-eight year old Caucasian male, Mr. Ambercrombie has had osteoarthritis of the knee for approximately twenty-five years. He reported that he does not take prescribed medication for his pain, however he does take aspirin. Mr. Ambercrombie reported that he has high blood pressure and diabetes, both conditions are

controlled with prescribed medication. Mr. Ambercrombie had not previously participated in an aquatic exercise program and he did not engage with an aquatic program while in the study. He had been regularly physically active for at least the last six months, seven days a week, thirty minutes or more each day. Mr. Ambercrombie displays a highly cognizant awareness of current events and his surroundings and he is very astute and personable. He indicated that he gets the social/emotional support that he needs, most of the time. During the first week of the study, because Mr. Ambercrombie's was face was getting red and he appeared to be getting overexerted during his engagement with the intervention, the investigator became concerned about the potential risk to his health and asked him to halt his involvement with the study. Mr. Ambercrombie participated at the YMCA II for three sessions.

Setting

There are two local YMCA facilities in the small Midwestern community near a large university where the study was conducted. Both facilities were under the same administration, and for the purposes of this study, are identified as YMCA-I and YMCA-II. YMCA-I is closer to the local university and downtown, it was opened in 1981 and is approximately 36 years old. A multipurpose aquatic therapy pool was added onto this facility and was opened for use in 2013. The YMCA-II was built and opened in 2013, this facility is further away from the university and downtown areas, and is in a rural area of the suburbs of town. The optimal time to have the participants engage with the intervention at each facility was between 1:00 to 5:00 pm. This was a time when the pools at each facility were being used the least by other patrons and or classes throughout a normal day. Instruction of the participants was on an individual basis, with a time allotment for each participant of one hour. This was to accommodate participant dressing/showering before and after the 40 minute in-pool intervention, the first

participant started at 1:00pm and the third participant ended at 5:00pm. It was the aim of the investigator to have all participants engage with the intervention at the YMCA-I facility, but the decks of the pool at the YMCA-I facility were being cleaned during the time of the intervention on Tuesday afternoons, closing the pool. It was determined that three participants would engage with the intervention at the YMCA II facility. Participants who engaged with the intervention on Mondays, Wednesdays, and Fridays were at the YMCA-I facility. Participants who engaged with the intervention on Tuesdays, Thursdays, and Saturdays were at the YMCA-II facility.

Outcome Instruments

Repeated measure instrument. To measure participant perceived pain, the VA version of the numerical pain rating scale (NPRS) was chosen for its validity, reliability, and ease of use. The NPRS is a single dimensional measurement of the intensity of pain in the human adult. The most used format for this instrument is a horizontal line with a vertical line at each end. At each end of the scale are words that indicate the intensity of pain from "no pain at all" corresponding to the number "0", to "the worst pain possible" corresponding to the number "10". The NPRS can be given by an administrator, through pencil and paper, self-report, or through verbal indication. Reliability through test retest, has been rated high for people with rheumatoid arthritis: r = 0.95, prior to and following physician examination. Validity has been shown to have a high correlation with the visual analog scale (VAS), for people with chronic ongoing pain and other rheumatic conditions, range of correlation: 0.86 – 0.95 (Hawker, 2011). The full instrument and clinical literature is available at:

http://www.rehabmeasures.org/Lists/RehabMeasures/PrintView.aspx?ID=891

The minimal important clinical difference in a change of intensity for chronic ongoing musculoskeletal pain is a decrease of one point, identified as "a little better", and is equal to a

15.0% change on the NPRS scale. A decrease in pain of two points is equal to a 30.0% change and is identified as "considerably better" (Salaffi, Stancati, Silvestri, Ciapetti, & Grassi, 2004).

Pretest health screen instruments. The following two instruments were used by the investigator to screen potential participants for physical and cognitive health issues that may preclude them from the study. The instruments were chosen for their high sensitivity and specificity, and their ease of administration.

1. The study used the Physical Activity Readiness Questionnaire for Everyone (PAR-Q+), to screen potential participants for risks to their health while physically involved in the study. The physical activity assessment is a very simple and easy to answer questionnaire that can be self-administered to determine if an increase in an individual's physical activity is warranted. The instrument has a specificity of 80% and sensitivity of close to 100% in relation to identifying contraindications of a medical nature that could be a restriction to an individual becoming more physically active (Cardinal & Cardinal, 2000). The official full instrument is available at: www.eparmedx.com
2. To assess cognitive ability of potential participants, the study used the Cognitive Assessment Screening Test (CAST) to screen for symptoms of dementia. The CAST can detect the impairment of an individual's cognitive ability having a specificity of 88% and a sensitivity of 100%. As a screening test for dementia, it is extremely useful and it possesses a specificity and sensitivity that is as good as or better, than the Mini-Mental State Examination (MMSE). The CAST questionnaire requires very little experience, training, or time to administer (Drachman et al., 1996). The full instrument, scoring, and clinical literature is available within the article *Screening for*

Dementia: Cognitive Assessment Screening Test (CAST):(Drachman & Swearer, 1996).

Pretest and posttest instruments. The following four pretest-posttest measure instruments are from the Senior Fitness Test Manual. The instruments from the test manual have been proven to be an invaluable testing resource for research purposes (Rikli & Jones, 2013).

1. Chair Stand in 30 Seconds Test: The function of this test is the assessment of lower body strength. Scoring: this test records how many times an individual can get up from a chair in 30 seconds. Validity: several studies indicate that the test performs well in the field at assessing the strength of the lower body, it is also highly correlated with measures used in a laboratory that have proven validity. Test-retest reliability: correlation coefficient (*R*) 0.89 and (CI) 0.79-0.93 (Rikli, 2013).
2. Chair Reach to Touch Toes Test: The function of the test is the assessment of the flexibility of the lower body, in particular, the flexibility of the hamstring. To perform the test, the individual sits toward the front end of the seat of a chair extending one leg straight-out while having the other leg bent at a 90^0 angle with the foot flat against the surface of the floor. The individual then reaches down with both arms having one hand on top of the other to touch their toes. Scoring: the gap between the tips of the middle fingers and the toe of the shoe is recorded as a negative number in inches. If the finger tips touch the toe of the shoe, it is recorded as a 0.00. If the tips of the fingers go past the toes, the measurement is made from the tip of the shoe to the tips of the middle fingers and recorded as a positive score. Criterion validity: *r* value of 0.61 – 0.89. Reliability test-retest: correlation coefficient (*R*) 0.95 and (CI) 0.92-0.97 (Rikli, 2013).

3. Scratch the Back Test: The function of the scratch the back test is the assessment of the flexibility of the upper body, in particular, the shoulder. To perform the test, the individual reaches with one arm and hand over the same shoulder and down the spine as much as attainable, while the other arm and hand starting at the waist, moves up the spine as much as attainable to try to get the tips of the middle fingers from both hands to meet and come together behind the back. Scoring: if there is a gap between the tips of the middle fingers, the gap is recorded as a negative number in inches. If the tips of the middle fingers touch, this is recorded as 0.00. If there is an overlap of the tips of the middle fingers, it is measured and recorded as a positive number. Criterion validity has not been corroborated, nonetheless, there is empirical evidence that backs up its content validity. Test-retest reliability: correlation coefficient (*R*) 0.96 and (CI) 0.94-0.98 (Rikli, 2013).
4. Eight Foot Get Up Go Test: The test assesses fundamental mobility. Research studies indicate the test yields valid and reliable outcomes when used with older adults (Nordin, Rosendahl, & Lundin-Olsson, 2006). The function of the test is the assessment of energetic balance and physical agility. To perform the test, the individual sitting in a chair, gets up and walks around a marker that is eight feet away, then returns to sit in the chair. A stopwatch is used to measure the amount of time from leaving to sitting back down in the chair. Test-retest reliability for this instrument: correlation coefficient (*R*) 0.95 and (CI) 0.92-0.97. It is related significantly to the Barthel activities of daily living index ($r = 0.78$), speed of gait ($r = 0.61$), and Berg Balance scale ($r = 0.081$):(Rikli, 2013).

The following two pretest-posttest measures were used to determine the relative health status of each participant.

1. Body Mass Index (BMI), this measurement assesses an individuals' body height relative to their body weight. BMI uses three weight ranges: less than or equal to an 18, indicates that the individual is under-weight; a BMI of 19 to 25, indicates a healthy status; and a number greater than, or equal to 26, indicates that the individual is overweight or obese (Rikli, 2013).
2. Blood Pressure (BP), high blood pressure is a known factor for the risk of coronary artery disease. It is identified as an indicator of stroke and heart disease that can be brought under control through medication, or a change in lifestyle. Screening for high blood pressure was a very important measure for this study because it generally does not have any noticeable signs or symptoms and cannot be recognized without measuring it ("Heart-health screenings," 2017). Measurement of participant blood pressure was performed using the Omron 3® series blood pressure monitor.

Retrospective pretest posttest instruments. The following three test measure instruments were used to measure participant perception of well-being, general self-efficacy, and pain self-efficacy respectively. These particular instruments were chosen for their validity and reliability, as well as, their ease of administration to the participants.

1. Arthritis Impact Measurement Scales-Short Form (AIMS2-SF), this instrument is a shorter rendition of the original Arthritis Impact Scales 2 (AIMS2) that was specifically designed to assess the social, physical, and psychological well-being of people who have arthritis. Reliability: the AIMS2-SF showed internal consistency with a Chronbach's alpha range of 0.75 – 0.87. Validity: the AIMS2-SF has a

benchmark validity that is comparable to similar measures of the status of health and disability. Compared with similar instruments that assess people with arthritis, the AIMS2-SF for the domains of symptoms and physical function, had higher responsiveness to change than the Visual Analog Scale and the Modified Health Assessment Questionnaire (mHAQ). Scoring of the AIMS2-SF ranges from zero to 10, with a lower score indicating better health (Gignac, A. M., Cao, Xingshan., McAlpine, Jessica., Badley, Elizabeth M., 2011). Clinical information is available at: https://eprovide.mapi-trust.org/instruments/arthritis-impact-measurement-scales

2. The New General Self-Efficacy (NGSE) scale assesses a person's belief in ability to accomplish tasks well in various activities. It is made up of eight parts that are rated on a Likert type 5-point scale with the responses going from: firm disagreement to firm agreement. Higher scores on this instrument indicate greater levels of general self-efficacy. Internal consistency from 0.85 to 0.90; the coefficient stability ranges from $r = 0.62$ to $r = 0.65$. Scoring for the New General Self-Efficacy Scale ranges from eight to 40, the higher the score, the higher perception the individual has of their level of self-efficacy (Scherbaum, Cohen-Charash, & Kern, 2006).
3. The Pain Self-Efficacy Questionnaire (PSEQ) is used to measure and assess an individual's belief in ability to accomplish daily life activities even though they are experiencing pain. Reliability during a three month test retest period indicated 0.73 with a $P< 0.001$ (Di Pietro et al., 2014). The measure instrument consists of ten questions that are on a graduated, seven-level Likert-type scale, from a level six of totally-confident, to a level zero of totally-not confident. Research on the measurement of the cognitive and physical ability aspects of the questionnaire,

indicate that it has very good reliability, validity, and internal consistency: Chronbach's alpha of 0.92 (Skidmore et al., 2015). Scoring for the pain self-efficacy questionnaire is from zero to 60, with a higher score reflecting a stronger belief in one's self-efficacy to complete a task regardless of their pain. A score of less than 20 on the PSEQ predicts that the person is at risk for depression and long term disablement. A score of 40 or higher indicates that an individual is more likely to have a favorable response from their engagement with an exercise routine, regardless of their pain (Tonkin, 2008).

Study Procedures

In the spring of 2017, upon approval of the Institutional Review Board (IRB), six research participants who met the criteria of the study, were recruited from within the local community, and participated with the aquatic intervention at two local Midwestern small-town YMCA facilities. The functional movement regimen, based on five functional movements used in daily life activities, was developed during the pilot study in the summer of 2016 at a large Midwestern university outdoor pool. To provide stability and continuity of the intervention, the instruction of the functional movement regimen was video recorded and shown during every intervention instruction session. A certified arthritis aquatics leader was enlisted to facilitate individual instruction of the functional movements to each participant for the intervention, in synchronization with, the pre-recorded instructional video. In addition, all intervention instruction and participation sessions were always at the same time and day for each participant.

The instruction and application of the intervention for this study was grounded in self-efficacy theory, and the selection, optimization, and compensation model of aging well. Thus, the study examined the effect of the treatment on participant perception of pain and status of

well-being (i.e. the dependent variables), using the aforementioned theory and model as a foundational framework to predict and explain participant behavior. The perceived intensity of knee and or hip pain was the primary dependent variable and perceived status of well-being was the secondary dependent variable. There were two treatments, i.e. the independent variables of the study. The primary treatment (A) was the instruction in, and engagement with, prescribed aquatic functional movement positions facilitated without the use of a stationary aquatic pole. The secondary treatment (B) was the instruction in, and engagement with, the same prescribed aquatic functional movement positions with the use of the stationary aquatic pole. Both interventions were introduced in a systematically randomized manner to three paired-cases of six older adult women age 61 to 81 with OA of the knee and or hip in shallow-water 3.50 feet deep, for a period of five weeks, at light intensity levels, three sessions per week; consisting of a five minute warm-up, 30 minute intervention, and a five minute cool-down, per session.

The entire process of the aquatic functional movement intervention was presented to the six older adult women participants in three segments. The first segment was the pre-intervention establishment of baseline measures conducted on one day for three hours, plus a telephone call to each participant asking their level of pain for the following six consecutive days. The second segment was a five week aquatic movement intervention in the pool, three sessions per week, 40 minutes each session for each participant. The third segment was collection of post-test measure data on one day for three hours.

Pilot study. During the summer of 2016, the investigator and a university nursing student who had experience with instructing aquatics programs, worked out the specific movements and timing of the intervention at the large Midwestern university outdoor pool. The pilot study culminated with a video of the instruction of the intervention professionally recorded

at an indoor pool on the university campus to be used for consistency of the instruction of the intervention.

Recruitment of participants. Six participants were selected from a pool of eligible participants sought through the distribution of informational flyers and on-line local volunteer mailing lists. Flyers were posted asking for volunteers at local community agencies such as: Older American facilities, the local YMCAs I and II, older adult park and recreation programs, and medical outpatient rheumatology and arthritis treatment offices. This recruitment strategy was similar to other studies (Suomi & Koceja, 2000).

Assistant training. The investigator enlisted the assistance of four students to act as non-key interacting research personnel. Each assistant had to meet the requirements of the IRB and HIPAA to be approved to interact with the participants of the study. The assistants were informed of the objectives and purpose of the research project before the beginning of the study. Prior to the beginning of the intervention at each YMCA facility, the investigator met with two assistants to form an instructional team for each facility. During the meetings with each team of assistants, the investigator and the assistants went through an orientation of the study, hands-on application of each test measure to be familiar with the administration of the tests, and an in-pool walk through of the intervention using the instructional video with the movements demonstrated by the investigator.

During the intervention, the role of the investigator was to facilitate the instruction of the movements to each individual participant along with the video. In consideration of student responsibility to their class schedules, each team of assistants shared the responsibility of making sure that one assistant would be at each intervention instruction session. The role of the assistant during each intervention session, was to take observational and contextual notes of participant

interaction with the intervention. Also, the assistant would show a copy of the NPRS to the participant at the end of each session and ask how they felt about the level of their pain before engaging with the intervention and then how they felt about the level of their pain after their involvement with the intervention.

Inclusion exclusion criteria. For inclusion in the study, participants had to be between 60 to 85 years old, and have been diagnosed with knee and or hip OA. Participants had to have the physical and cognitive ability to engage in the instruction of, and participation with the aquatic intervention with the ability to complete hand written questionnaires. Participants were also asked to climb a stairway without the use of crutches or other assistance, and walk approximately 300 feet without assistance. Participants were excluded for the following criteria: recent injection of steroids, current participation with an aquatic exercise program, reports of untreated cardiovascular disease, stroke, or untreated high blood pressure, latter stages of dementia or Parkinson's disease, or not getting the approval of their physician to take part in the intervention.

Randomization of participants. Prior to beginning the study, the participants were randomly assigned to one of three paired-cases. By pairing the participants, each participant of each case-pair at the same session within the intervention, crossed over to the opposite treatment that they began the intervention with at a randomly selected crossover session. Thus, strengthening the ability of the investigator to determine the effect of the two treatments of the intervention on the participants' perceived pain.

Individual participants were randomly assigned into case-pairs by putting numbers on pieces of paper that represented each participant, into a hat. The first four numbers were drawn, one at a time, out of the hat by an impartial individual with no connection to the study, the

remaining two numbers were, by default, the third case-pair of participants. To randomly select which participant of each case-pair started the intervention on the wall or on the pole first, both numbers of the case- pair were put into a hat and an impartial individual pulled one number out of the hat. The first number pulled started the intervention on one of two randomly selected treatments, while the other participant of the case-pair automatically started with the opposite treatment. To randomly designate which treatment that the first randomly selected individual of each case-pair would start the intervention along the wall of the pool, or on the pole first, was implemented by putting the words "wall" and "pole" on pieces of paper into a hat. The first word pulled from the hat would designate the treatment that the first randomly selected participant of each case-pair started the intervention. To randomly designate the crossover begin point for each case-pair, the numbers six through 10 were put on pieces of paper and put into a hat. One number was drawn out of the hat to designate the crossover begin point for the first case-pair. That number was put back into the hat and one number was drawn to designate the crossover begin point for the second case-pair. Again, the number that was pulled was put back into the hat and one number was drawn from the hat to designate the crossover begin point for the third case-pair.

Randomized case-pairs.

Case-pair 1. Randomly assigned pairing of participants Mrs. Messina and Mrs. Calloway; randomly selected that Mrs. Calloway starts on pole; randomly selected to crossover to opposite treatment at session #6.

Case-pair 2. Randomly assigned pairing of participants Mrs. Ulrich and Ms. Pace; randomly selected that Mrs. Ulrich starts on wall; randomly selected to crossover to opposite treatment at session #8.

Case-pair 3. Randomly assigned pairing of participants Mrs. Jeffers and Mrs. Sage; randomly selected that Mrs. Jeffers starts on wall; randomly selected to crossover to opposite treatment at session #9.

Intervention. The study was comprised of three segments: A' (pretesting for baseline), AB (intervention), and post-testing.

A': After signing the informed consent document and prior to further participation in the study, participants were asked to provide documents about their current involvement in regular physical activity, their past and current health status in general (PAR-Q+), and also asked to walk up a flight of stairs and walk approximately 300 feet without the use of crutches or assistance to participate in the study. The participants were also asked to fill out a hand written questionnaire testing their cognitive ability (CAST). If the participant passed all of the above criteria, they were given the following measures and tests: participant blood pressure (BP), height and weight measured and recorded for body mass index (BMI), balance and basic mobility (Eight Foot Get Up Go test), lower and upper body flexibility (Back Scratch test and Sit and Reach to Touch Toes test, respectively), and lower body strength (30 Second Chair Stand Test). Participants were then asked to fill out a demographic questionnaire to collect information on participant age, gender, height and weight, educational level, race, marital status, time with OA, medications, past surgery, and previous involvement in an aquatic therapy program. This testing occurred within a three hour session in a conference room at the YMCA I facility. The following day, each participant was telephoned at home in the morning hours at approximately 11:50 a.m. and asked to report their level of pain intensity using the numerical pain rating scale (NPRS). Participants received one phone call each day at the same time as the initial phone call, for the next five consecutive days to establish baseline levels of participant perceived pain.

AB: In this segment, participants engaged with two treatments for five weeks, three days per week for a total of 15 intervention sessions. The aquatic functional movement intervention was introduced to six older adult women in shallow-water (depth of 3 feet 6 inches). The water temperature was between 85 and 86 ^{o}F, this met the 2014 recommendations of the Aquatic Exercise Association Standards and Guidelines (2014): of temperatures between 83 and 88 ^{o}F, for older adults with arthritis ("Aquatic Exercise Association: Standards & guidelines," 2014).

Participants engaged in the instruction of the intervention treatments individually. The order in which each participant engaged without the pole first, or with pole first, was randomly determined. Participants began one-on-one engagement with a certified aquatics arthritis leader along with the aid of an instructional video of the functional movements; three sessions per week, for 40 minutes each session. From a sub-set of five pre-determined sessions (sessions six through ten), within the 15 daily sessions of the intervention, one session within the subset of five sessions was randomly selected as a simultaneous crossover begin point session for each case-pair of participants. This randomly selected crossover begin point session is where each case-pair of participants switched from the treatment that they began the intervention with, to engage in the opposite treatment, for the remainder of the five-week aquatic intervention. During this five-week segment, before coming to each daily session, each participant was called at approximately 11:50 a.m. and asked over the telephone, to respond to the numerical pain rating scale questionnaire (NPRS), about the level of the intensity of their pain (see A", Table 3.1). Immediately after each daily session when each participant exited the pool, the participant was asked to respond to the NPRS questionnaire as to how the participant felt about the level of their pain prior to engaging with the intervention and then asked how they presently perceived their level of pain after the intervention.

All of the movements involved with the intervention were slow walking and stretching in the water, at light intensity. All interacting personnel and the participants were educated to be aware of, and watch for, warning signs of an adverse cardiovascular event. Also, the investigator and both life guards were CPR-AED certified and both of the local YMCA's I and II had an emergency protocol in place to respond to adverse health events. Because the water temperature was at the lower end of the optimal temperature of 83 to 88 ^{o}F, participants were periodically asked how they felt temperature-wise about the water.

Post testing: In this third segment, all participants met with the investigator for one three-hour session. This meeting took place in a program room at the YMCA I facility. Participants had their BP, and BMI recorded, also tested for dynamic balance and basic mobility, lower and upper body flexibility, and lower body strength. The participants were then asked to fill out three measure instruments, the AIMS2-SF, the NGSE, and the PSEQ questionnaires. In accordance with research indicating best order of retrospective pretest administration to control for response shift bias, the participants were first asked to fill out the three test measure instruments for post-testing, then later in the session, they were again asked to fill out the same test measure instruments and asked to think back before their involvement in the study, to answer the questions retrospectively (Nimon, Zigarmi, & Allen, 2011).

Equipment. One, AcquaPole®. The apparatus consists of a 31.50-inch diameter hard plastic disc that is 0.75 inches thick. In the center of the disc, is a 1.50 inch threaded sleeve that a six-foot-long, 1.50 inch diameter stainless steel pipe threaded at one end to the same threading as the sleeve, screws securely into. On the underneath of the hard plastic disc, are ten 3.50-inch diameter suction cups, designed to adhere to the bottom of a pool to facilitate movements holding onto the pole in shallow water.

Pretest and posttest materials.

1. Standard folding chairs, one for each participant to do warm up exercises before testing. One folding chair was designated to be used for the testing of two performance measurements. The top of the seat of the chair should be at 17 inches from the floor.
2. One Stopwatch.
3. Masking tape.
4. One tape measure at least ten feet long.
5. One small plastic cone nine inches tall, with a 5.25-inch square base.
6. One 60 inch cloth fabric tailor's measuring tape to measure participant height.
7. One 18 inch ruler.
8. Pencils for filling out questionnaires.
9. One 12 inch goniometer.
10. One Omron® 3 series automatic digital blood pressure monitor.

Study Design

Single-case randomized and replicated two-treatment crossover method. The study used a replicated two-treatment randomized single-case crossover design to assess the effect of the aquatic functional movement intervention on participant perceived pain and well-being. The single-case simultaneous crossover treatment begin point method is a treatment comparison procedure that can be modified to, in essence, capture the equivalence of the traditional two group research crossover design. With the single-case simultaneous crossover treatment begin point method, two participants were paired to make a single case with each participant of the case-pair receiving a different beginning treatment. At a predetermined randomized crossover point within the two treatment intervention, each participant of the case-pair switched to the

opposite treatment that they began with at the same time. For the study, there were two rival treatments: A (movements without the pole) and B (movements with the pole), that were administered to each member of each paired case in one of two potential orders of treatment. In the first treatment order (a), one case-pair participant was randomly assigned to receive treatment A then receive treatment B. In the second treatment order (b), the other participant from the same case-pair, first received treatment B then received treatment A. Each participant within their respective case, crossed over to the opposite treatment that they were initially introduced to at the same session, as shown in (Table 3.1). This method of paired participants, randomly assigned to one of two randomly ordered treatment sequences, become the single case equivalent of the traditional crossover group design (Ferron, 2014).

Table 3.1

Two-Treatment (AB) Randomized Order and Begin Point Case-Pair Crossover Method

Week →			1			2			3			4			5		
Baseline ↓	Session →		1	2	3	4	5	**6**	**7**	**8**	**9**	**10**	11	12	13	14	15
	Pain a.m. →		A″	A″	A″	A″	A″	A″	A″	A″	A″	A″	A″	A″	A″	A″	A″
CP-1	A′	Mrs. M-a	A	A	A	A	A	**B***	B	B	B	B	B	B	B	B	B
	A′	Mrs. C-b	B	B	B	B	B	**A***	A	A	A	A	A	A	A	A	A
CP-2	A′	Mrs. U-a	A	A	A	A	A	A	A	**B***	B	B	B	B	B	B	B
	A′	Ms. P-b	B	B	B	B	B	B	B	**A***	A	A	A	A	A	A	A
CP-3	A′	Mrs. J-a	A	A	A	A	A	A	A	A	**B***	B	B	B	B	B	B
	A′	Mrs. S-b	B	B	B	B	B	B	B	B	**A***	A	A	A	A	A	A

Note: (*) Denotes randomized simultaneous paired-case crossover treatment begin point.

A′= Establishment of the baseline pre-treatment: (all participants: one phone call to each participant for six consecutive days at approximately 11:50 a.m.). For a total of six pain measures per participant.

A′′= Morning pain measures: (all participants: one phone call to each participant prior to each intervention session at approximately 11:50 a.m.). For a total of 15 pain measures per participant.

A = Treatment phase: two pain observations/measures per session without the stationary pole.

B = Treatment phase: two pain observations/measures per session with the pole.

CP = Case pair.

a= Begin treatment order with A treatment phase.

b= Begin treatment order with B treatment phase.

Five week treatment period after baseline phase, three every other day sessions for a total of 15 sessions. Each session, two pain measures after treatment for retrospective pretests and posttests for a total of 30 pain measures per participant.

Case-pairs were randomly assigned to a treatment session crossover point from a group of predetermined treatment sessions that are from session six to ten (numbers in bold Table 3.1).

Participant Data

The following are participant profiles composed from collected data on each participant. The data were compiled from each participant's individual responses to four test measures from the Senior Fitness Test Manual, as well as, the AIMS2-SF; NGSE; and the PSEQ questionnaires. Accompanied with the profile of each participant, are charts generated from repeated pain measure data using the Microsoft Excel 2013 data analysis software.

Mrs. Messina. The following four tables display data from the measure instruments outlined above and are accompanied with comments related to the interpretation of Mrs. Messina's data.

Table 3.2

Mrs. Messina. Senior Fitness Test Manual Scores

Test Item	Pretest Scores	Posttest Scores	Absolute Difference	Percent Change
Chair Stand in 30 Seconds	15	17	2.00	13.33%
Chair Reach to Touch Toes	1.00″	-0.50″	-1.50″	150%
Scratch the Back	-3.75″	-2.00″	1.75″	47.70%
Eight Foot Get Up Go	5.2 seconds (s)	3.90 s	1.30 s	25%

Comparing Mrs. Messina's pretest scores with posttest scores: chair stand test: two more stands on the posttest than pretest, indicating improvement in lower body strength. Chair reach test: she did not reach as far on the posttest by 1.5 inches, indicating a decrease in lower body flexibility. Scratch the back test: she closed the gap between her fingers by 1.75 inches more on posttest, indicating improvement in upper-body flexibility. Eight foot get up go test: the time was 1.30 seconds (s) less than pretest, indicating improvement in agility and dynamic balance.

Table 3.3

Mrs. Messina. AIMS2-SF Scores

Parameter	Retrospective Pretest Scores	Posttest Scores	Absolute Difference	Percent Change
Physical Function	1.67	1.46	-0.21	12.57%
Symptoms	3.33	2.50	-0.83	24.92%
Affect	2.50	3.00	0.50	20.00%
Social Interaction	6.25	4.37	-1.88	30.08%

Comparison of retrospective pretest and posttest scores indicate a positive change in physical function, down from 1.67 to 1.46, and symptoms, down from 3.33 to 2.50. A small

negative change in affect, up from 2.50 to 3.00. A positive change in social interaction going down from 6.25 to 4.37. Interpretation: after participation with the intervention there was improvement in both physical function, and symptoms. Affect went up by one-half of one point, this possibly may be due to her knee surgery that was scheduled three days after post testing. The positive change in social interaction, indicates a perceived improvement in social relations.

Table 3.4

Mrs. Messina. New General Self-Efficacy Scale Scores

Retrospective Pretest Score	Posttest Score	Percent Change
27	27	0%

Comparison of Mrs. Messina's retrospective pretest and posttest NGSE scores indicate an average (range = 27 to 31) perception of general self-efficacy. Her perception of self-efficacy did not change and remained stable during participation in the study.

Table 3.5

Mrs. Messina. Pain Self-Efficacy Questionnaire Scores

Retrospective Pretest Score	Posttest Score	Percent Change
44	43	2.27%

Comparison of Mrs. Messina's retrospective pretest score with the posttest score, there was no appreciable change in level of pain self-efficacy, it essentially remained stable. During the intervention, Mrs. Messina's ability to stay with the study regardless of level of pain was evidenced by not missing any treatment sessions.

The following three figures display Mrs. Messina's pain data from baseline, morning (a. m.), and retrospective pretest and posttest measures, respectively. Each figure is accompanied with comments related to the interpretation of the data.

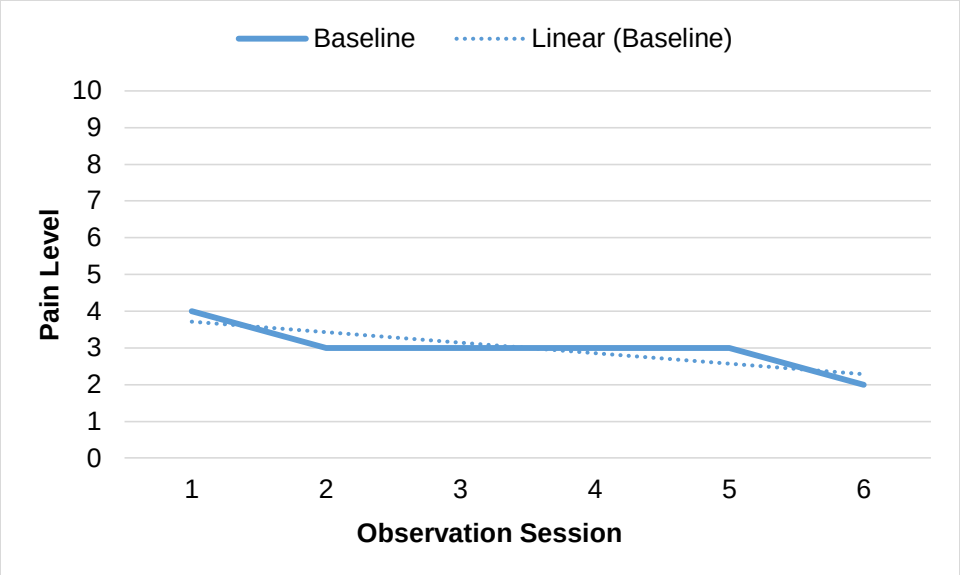

Figure 3.1. Mrs. Messina. Baseline pain level measures.

Baseline pain measures.

Level: mean of baseline (*M* = 3.00) perceived pain.

Trend: slope line of best fit indicates a gradual downward progression.

Variability: Data range around line of best fit from level 3.75 to 2.30.

Fluctuation around the mean (*SD* = 0.63).

Interpretation of Mrs. Messina's baseline measures is that it was not clear that her perceived pain levels had stabilized.

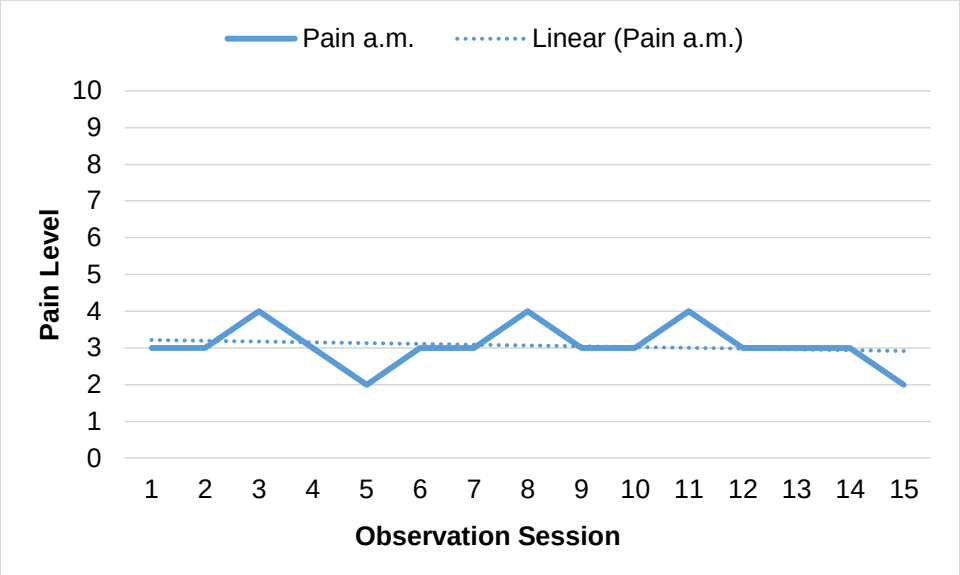

Figure 3.2. Mrs. Messina. Morning pain level measures.

Morning pain.

Level: mean of a.m. data (*M* = 3.07) perceived pain.

Trend: slope line of best fit indicates a very slight downward progression.

Variability: data range around line of best fit from a level 3.20 to 3.00.

Fluctuation around the mean (*SD* = 0.59).

Interpretation of the difference between the means of Mrs. Messina's baseline measures (*M* = 3.00) level of pain, and mean of a. m. measures (*M* = 3.07) indicates a very small increase in pain from baseline to the a.m. measures while participating with the intervention (Δ = 3.07 – 3.00 = 0.07).

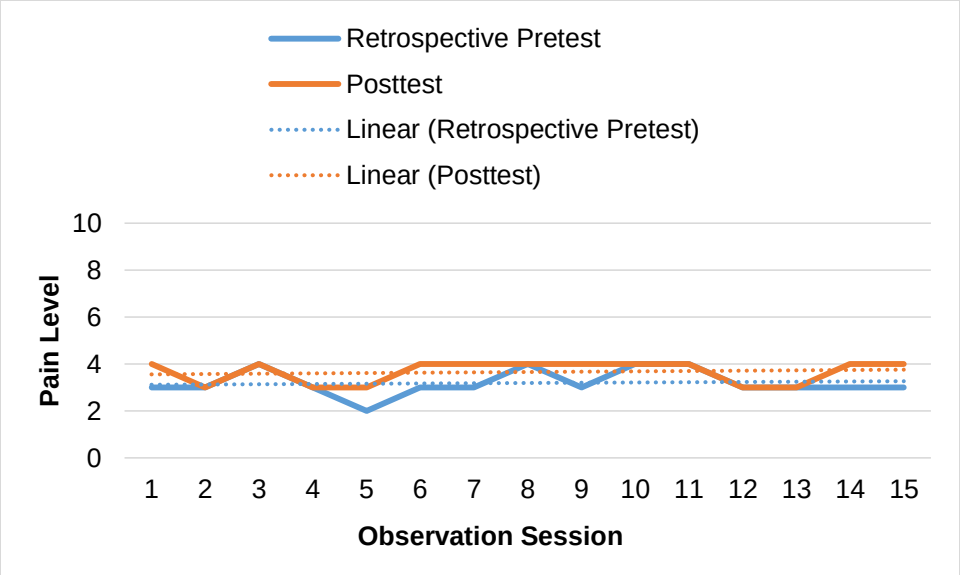

Figure 3.3. Mrs. Messina. Retrospective pretest to posttest pain measures.

Retrospective Pretest.

Level: mean of pretest data (M = 3.20) perceived pain.

Trend: slope line of best fit indicates a very slight upward progression.

Variability: data range around line of best fit from level 3.00 to 3.20.

Fluctuation around the mean (SD = 0.56).

Posttest.

Level: mean of posttest data (M = 3.67) perceived pain.

Trend: slope line of best fit indicates a slight upward progression.

Variability: data range around line of best fit from between a level 3.50 to 3.80.

Fluctuation around the mean (SD = 0.49).

These data indicate that Mrs. Messina's perceived mean level of pain showed an increase (Δ = 3.67 – 3.20 = 0.47), during engagement with the intervention.

Mrs. Ulrich. The following four tables display data from the measure instruments outlined above and are accompanied with comments on the interpretation of Mrs. Ulrich's data.

Table 3.6

Mrs. Ulrich. Senior Fitness Test Manual Scores

Test Item	Pretest Scores	Posttest Scores	Absolute Difference	Percent Change
Chair Stand in 30 Seconds	13	15	2	15.38%
Chair Reach to Touch Toes	7.50″	11.00″	3.50″	47%
Scratch the Back	-2.50″	-2.50″	0.00″	N/C
Eight Foot Get Up Go	4.30 seconds (s)	3.40 s	0.90 s	21%

Note: N/C stands for no change.

Comparing Mrs. Ulrich's pretest scores with posttest scores: chair stand test: she did two more stands on the posttest, indicating an increase in lower body strength. The chair reach test: she reached farther on the posttest by 3.5 inches, indicating an increase in lower body flexibility. The scratch the back test: no change from pretest to posttest, indicating no improvement in upper-body flexibility. The eight foot get up go test: time decreased by 0.90 s, indicating an improvement in agility and dynamic balance.

Table 3.7

Mrs. Ulrich. AIMS2-SF Scores

Parameter	Retrospective Pretest Scores	Posttest Scores	Absolute Difference	Percent Change
Physical Function	2.09	1.46	-0.63	30.14%
Symptoms	4.17	0.00	-4.17	100%
Affect	4.50	0.00	-4.50	100%
Social Interaction	8.13	8.13	0.00	N/C

Note: N/C stands for no change.

Comparison of Mrs. Ulrich's retrospective pretest and posttest scores indicate there was an improvement in perceived physical function, down from 2.09 to 1.46, improvement in symptoms, down from 4.17 to 0.00, and affect, down from 4.50 to 0.00. There was no change in score of 8.13 for social interaction. Interpretation of retrospective pretest and posttest scores indicate after participation with the intervention, she perceived improvement in physical

function, symptoms, and affect showing marked improvement. Her score of 8.13 for social interaction, did not change. Because the instruction of the intervention was implemented to each participant individually, it did not provide a forum for social interaction and may help to explain Mrs. Ulrich's perceived lack of social interaction.

Table 3.8

Mrs. Ulrich. New General Self-Efficacy Scale Scores

Retrospective Pretest Score	Posttest Score	Percent Change
29	23	20.69%

Comparison of Mrs. Ulrich's retrospective pretest and posttest NGSE scores indicate that perception of general self-efficacy went down by six points, down from a 29 (average range = 27 to 31), to a 23 (low range = 8 to 23). This was a drop in level of general self-efficacy by (20.69%).

Table 3.9

Mrs. Ulrich. Pain Self-Efficacy Questionnaire Scores

Retrospective Pretest Score	Posttest Score	Percent Change
28	53	89.29%

Mrs. Ulrich's PSEQ scores went from a retrospective pretest score of 28, to posttest score of 53, (89.29%) change. Comparing the retrospective pretest score with the posttest score, it is evident that there was a positive change in level of pain self-efficacy. During the intervention, Mrs. Ulrich's ability to stay with the study regardless of level of pain, was evidenced by not missing any treatment sessions. Comparing her NGSE and PSEQ scores, they are contradictory.

The following three figures display pain data from baseline, morning (a.m.), and retrospective pretest and posttest measures, respectively. Each figure is accompanied with comments related to the interpretation of the data.

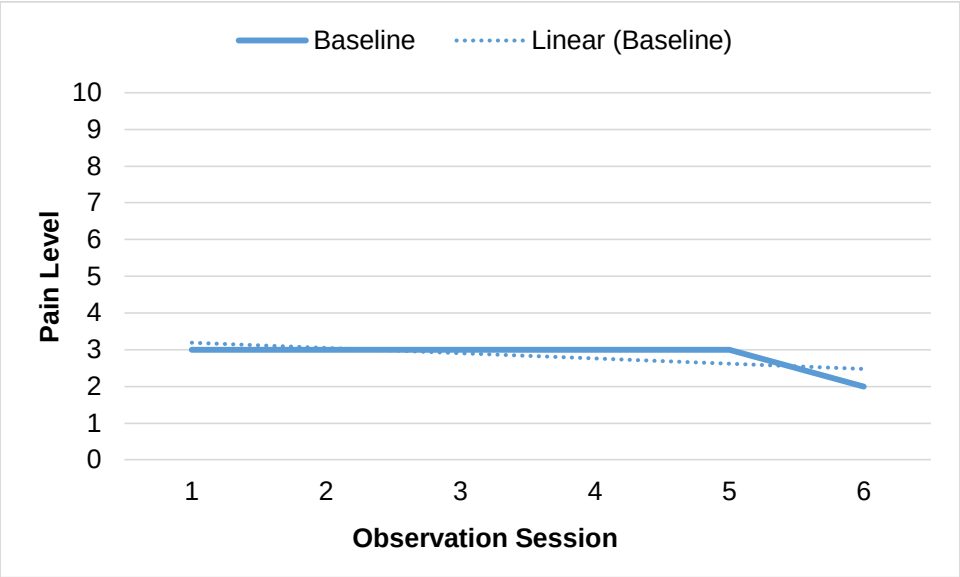

Figure 3.4. Mrs. Ulrich. Baseline pain level measures.

Baseline pain measures.

Level: mean baseline (*M* = 2.83) perceived pain.

Trend: slope line of best fit indicates a slight downward progression.

Variability: data range around line of best fit from a level 3.00 to 2.50.

Fluctuation around the mean (*SD* = 0.41).

Interpretation of Mrs. Ulrich's baseline measures are that level of pain went for five measures at 3.0 then went down to a level 2.00. Baseline did not achieve stability as it started to go down, making it difficult to predict a future trend.

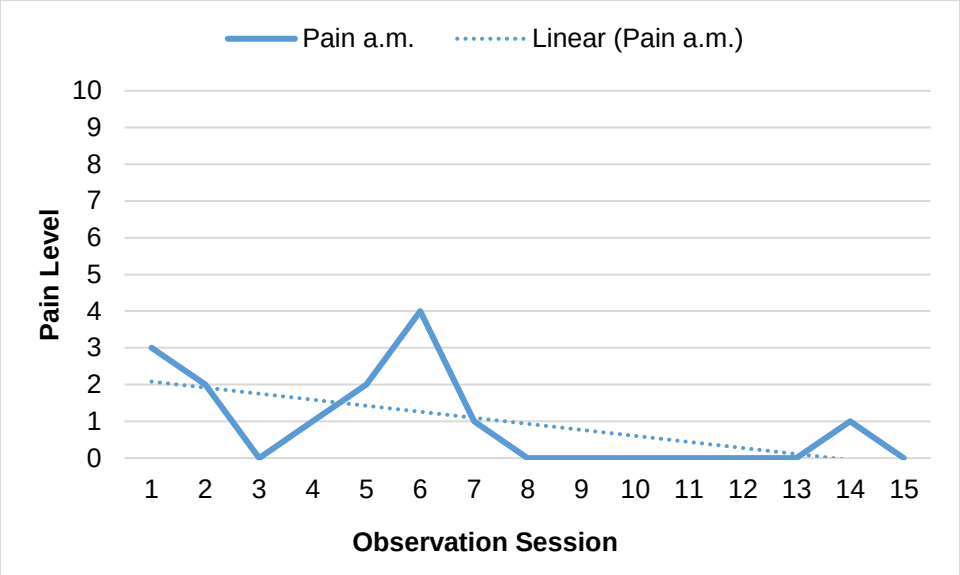

Figure 3.5. Mrs. Ulrich. Morning pain level measures.

Morning pain measures.

Level: mean of a. m. data (*M* = 0.93) perceived pain.

Trend: slope line of best fit indicates a downward progression.

Variability: data range around line of best fit from a level 2.00 to 0.00.

Fluctuation around the mean (*SD* = 1.28).

Interpretation of the difference between the means of Mrs. Ulrich's baseline score (*M* = 2.83) level of pain, and mean of a. m. measures (*M* = 0.93) indicates a decrease in pain from baseline ($\Delta = 0.93 - 2.83 = -1.90$) to a.m. measures. This change in pain is close to the two point "considerably better" clinical minimum for the NPRS scale.

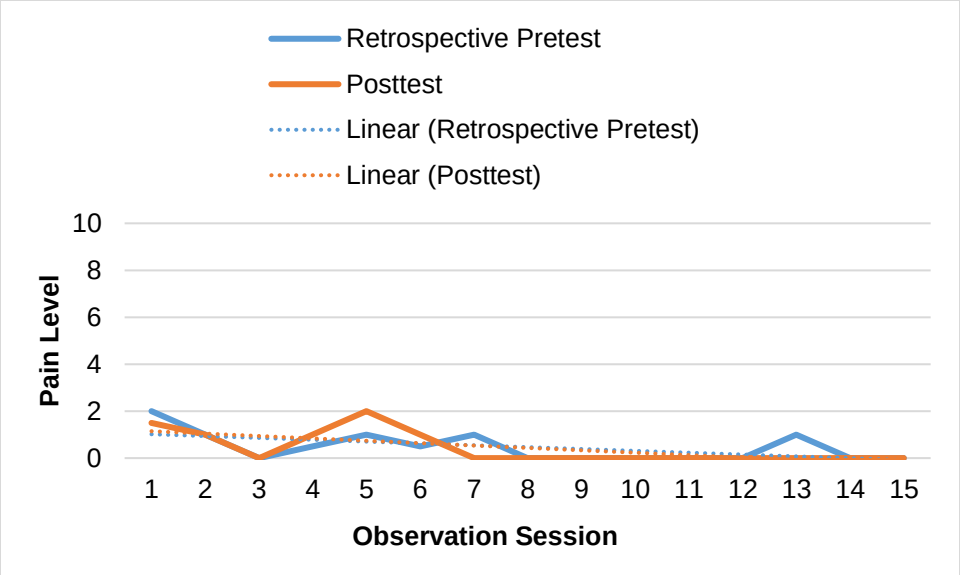

Figure 3.6. Mrs. Ulrich. Retrospective pretest to posttest pain measures.

Retrospective Pretest.

Level: mean of retrospective pretest data (M = 0.47) perceived pain.

Trend: slope line of best fit indicates a very slight downward progression.

Variability: data range around line of best fit from a level 1.00 to 0.00.

Fluctuation around the mean (SD = 0.61).

Posttest.

Level: mean of posttest data (M = 0.43) perceived pain.

Trend: slope line of best fit indicates a very slight downward progression.

Variability: data range around line of best fit from between a level 1.00 to 0.00.

Fluctuation around the mean (SD = 0.68).

Interpretation of the comparison of the retrospective pretest measures to the posttest measures indicate her level of pain showed a very small decrease at posttest (Δ = 0.43 – 0.47 = -0.04).

Mrs. Calloway. The following four tables display data from the measure instruments outlined above and are accompanied with comments related to the interpretation of Mrs. Calloway's data.

Table 3.10

Mrs. Calloway. Senior Fitness Test Manual Scores

Test Item	Pretest Scores	Posttest Scores	Absolute Difference	Percent Change
Chair Stand in 30 Seconds	8	12	4	50%
Chair Reach to Touch Toes	-3.50″	-2.50″	1.00″	28.57%
Scratch the Back	-2.50″	-1.50″	1.00″	40%
Eight Foot Get Up Go	7.40 seconds (s)	5.20 s	-2.30 s	29.72%

Comparing Mrs. Calloway's pretest scores with posttest scores: chair stand test: she did four more stands on posttest, indicating an increase in lower body strength. Chair reach to touch toes test: she reached farther to close the gap by 2.00 inches, indicating an increase in lower body flexibility. Scratch the back test: she closed the gap between her fingers by 1.00 inch, indicating improvement in upper-body flexibility. Eight foot get up go test: she lowered the amount of time by 2.30 s indicating improvement in agility and dynamic balance.

Table 3.11

Mrs. Calloway. AIMS2-SF Scores

Parameter	Retrospective Pretest Scores	Posttest Scores	Absolute Difference	Percent Change
Physical Function	2.72	2.09	-0.63	23.16%
Symptoms	7.50	6.66	-0.84	11.20%
Affect	5.50	3.50	-2.00	36.36%
Social Interaction	5.00	4.38	-0.62	12.40%

Comparison of Mrs. Calloway's scores indicate a positive change in physical function, down from 2.72 to 2.09. A positive perceived change in symptoms, down from 7.50 to 6.66.

Affect, improved going down from 5.50 to 3.50. Social interaction improved, down from 5.00 to 4.38. Interpretation of scores indicate after participation with the intervention, there was perceived improvement in all four measures of perceived well-being.

Table 3.12

Mrs. Calloway New General Self-Efficacy Scale Scores

Retrospective Pretest Score	Posttest Score	Percent Change
17	20	17.65%

Comparison of Mrs. Calloway's NGSE scores indicate during participation in the study, level of general self-efficacy went up from a 17 to a 20, both scores are in the low range of (8 to 23) for this scale. Mrs. Calloway had a positive change in general self-efficacy by (17.65%).

Table 3.13

Mrs. Calloway Pain Self-Efficacy Questionnaire Scores

Retrospective Pretest Score	Posttest Score	Percent Change
21	30	42.86%

Mrs. Calloway's scores improved from the retrospective pretest 21, to posttest 30. There was a positive change in level of pain self-efficacy. Mrs. Calloway's ability to stay with the study regardless of her level of pain, was evidenced by her completion of the study.

The following three figures display pain data from baseline, morning (a.m.), and retrospective pretest and posttest measures, respectively. Each figure is accompanied with comments related to the interpretation of the data.

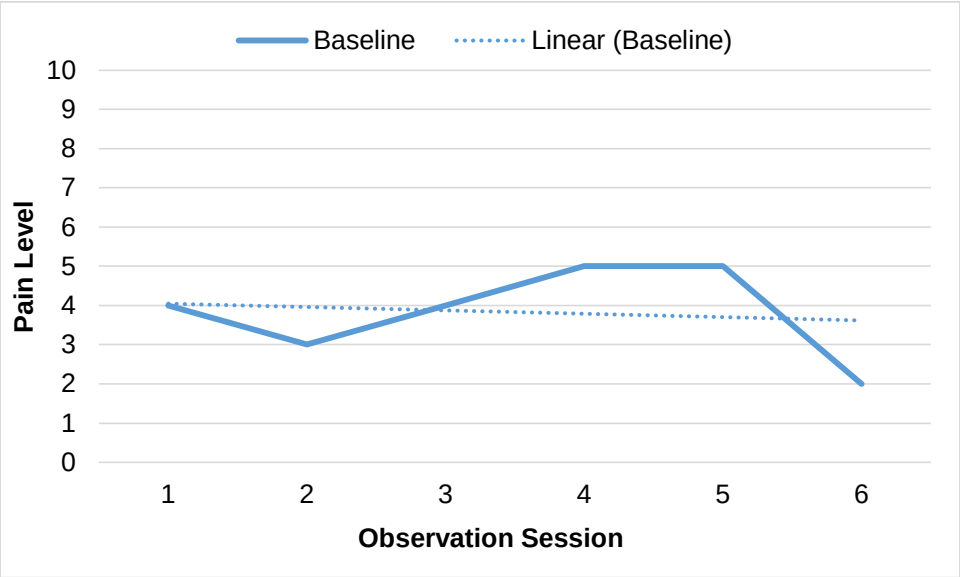

Figure 3.7. Mrs. Calloway. Baseline pain level measures.

Baseline pain measures.

Level: mean baseline data is (*M* = 3.83) perceived pain.

Trend: slope line of best fit indicates a slight downward progression.

Variability: data range around line of best fit from a level 4.00 to 3.60.

Fluctuation around the mean (*SD* = 1.17).

Interpretation of Mrs. Calloway's baseline measures, there was no established stability making it hard to predict a future trend.

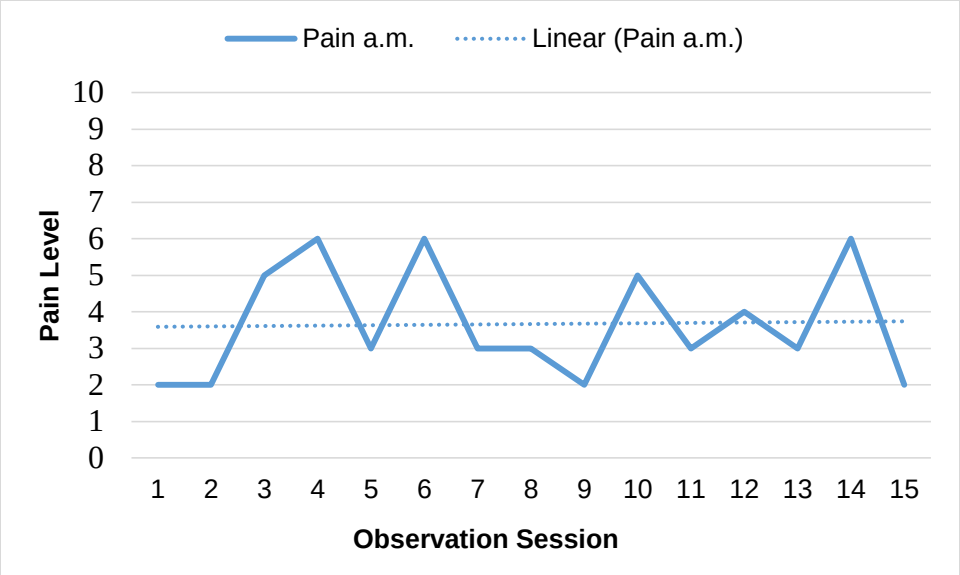

Figure 3.8. Mrs. Calloway. Morning pain level measures.

Morning pain.

Level: mean of a. m. data (*M* = 3.67) perceived pain.

Trend: slope line of best fit indicates a slight upward progression.

Variability: data range around line of best fit from a level 3.60 to 3.80.

Fluctuation around the mean (*SD* = 1.54).

Interpretation of the difference between the means of baseline (*M* = 3.83), and a. m. measures (*M* = 3.67) indicates a decrease in mean pain level from baseline (Δ = 3.67 – 3.83 = -0.16). Comparing Mrs. Calloway's baseline to a. m. mean pain levels indicates there was a small decrease in perceived level of pain during participation with the intervention.

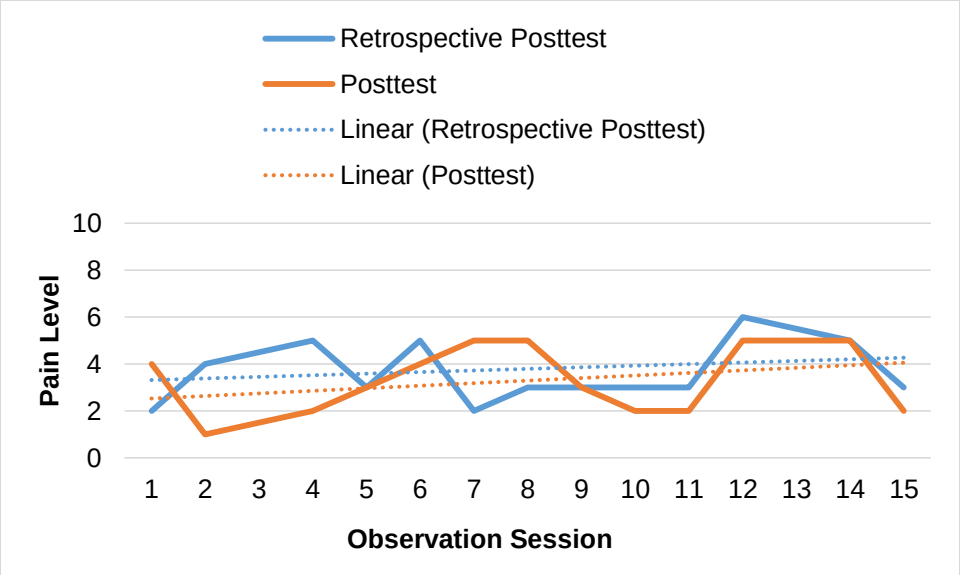

Figure 3.9. Mrs. Calloway. Retrospective pretest to posttest pain measures.

Retrospective Pretest.

Level: mean of pretest data (*M* = 3.80) perceived pain.

Trend: slope line of best fit indicates a gradual upward progression.

Variability: data range around line of best fit from a level 3.30 to 4.20.

Fluctuation around the mean (*SD* = 1.28).

Posttest.

Level: mean of posttest data (*M* = 3.30) perceived pain.

Trend: line of best fit slope indicates a gradual upward progression.

Variability: data range around line of best fit from between a level 2.50 to 4.00.

Fluctuation around the mean (*SD* = 1.49).

Interpretation of Mrs. Calloway's level of pain showed a decrease (Δ = 3.30 – 3.80 = -0.50), after engagement with the intervention.

Mrs. Jeffers. The following four tables display data from the measure instruments outlined above and are accompanied with comments related to the interpretation of the data.

Table 3.14

Mrs. Jeffers Senior Fitness Test Manual Scores

Test Item	Pretest Scores	Posttest Scores	Absolute Difference	Percent Change
Chair Stand in 30 Seconds	16	24	8	50%
Chair reach to touch toes	6.25″	8.00″	1.75″	28%
Scratch the Back	-0.875″	1.00″	1.875″	214.29%
Eight foot Get Up Go	4.30 seconds (s)	3.80 s	0.50 s	11.63%

Comparing Mrs. Jeffers' pretest scores with posttest scores: chair stand test: she did eight more stands on the posttest, indicating an improvement in lower body strength. Chair reach toes test: she reached farther past her toes on the posttest, indicating improvement in lower body flexibility. Scratch the back test: she closed the gap between fingers by -0.875″ on the pretest, to overlapping the fingers by 1.00″, on posttest, indicating improvement in upper-body flexibility. Eight foot get up go test: she lowered the amount of time by 0.50 s, indicating improvement in agility and dynamic balance.

Table 3.15

Mrs. Jeffers AIMS2-SF Scores

Test Parameter	Retrospective Pretest Scores	Posttest Scores	Absolute Difference	Percent Change
Physical Function	1.05	0.84	-0.21	20.00%
Symptoms	6.66	1.67	-4.99	74.92%
Affect	1.50	0.00	-1.50	100.00%
Social Interaction	5.00	3.75	-1.25	25.00%

Comparison of Mrs. Jeffers' scores indicate a positive change in physical function, down from 1.05 to 0.84, substantial change in symptoms, down from 6.66 to 1.67, affect went down from 1.50 to 0.00, and social interaction, down from 5.00 to 3.75. After participation with the intervention, there was improvement in all four measures of perceived well-being.

Table 3.16

Mrs. Jeffers New General Self-Efficacy Scale Scores

Retrospective Pretest Score	Posttest Score	Percent Change
33	32	3.03%

Comparison of Mrs. Jeffers' NGSE scores show perceived general self-efficacy went down by one point and indicate that her perception of general self-efficacy remained stable.

Table 3.17

Mrs. Jeffers Pain Self-Efficacy Questionnaire Scores

Retrospective Pretest Score	Posttest Score	Percent Change
43	55	27.91%

Mrs. Jeffers' scores changed from pretest 43, to posttest 55, an increase of 12 points. It is evident that there was a positive change in perceived level of pain self-efficacy. During the intervention, Mrs. Jeffers' ability to stay with the study regardless of level of pain, was evidenced by her missing just one session and completing the study.

The following three figures display pain data from baseline, morning (a.m.), and retrospective pretest and posttest measures, respectively. Each figure is accompanied with comments related to the interpretation of the data.

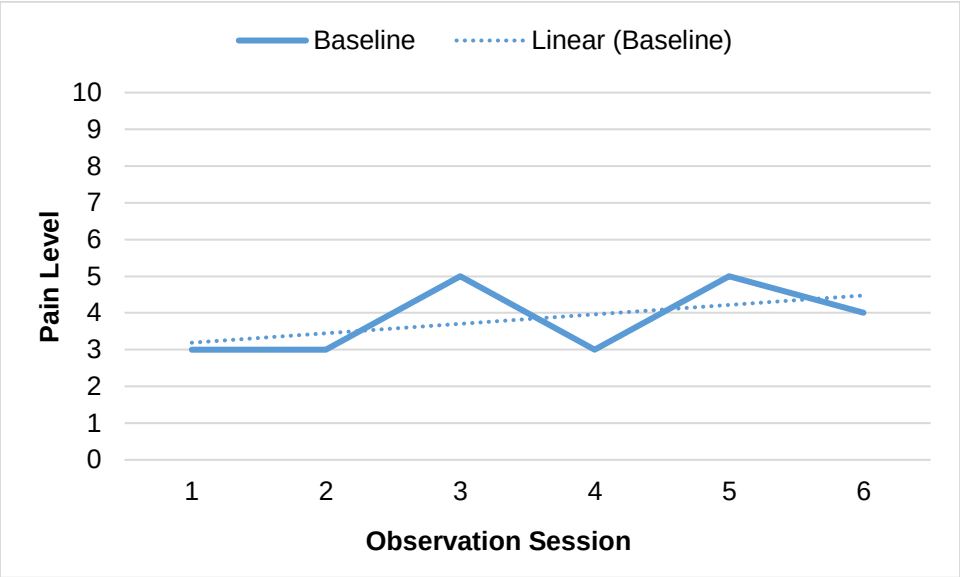

Figure 3.10. Mrs. Jeffers. Baseline pain level measures.

Baseline pain measures.

Level: mean baseline data (*M* = 3.83) perceived pain.

Trend: slope line of best fit indicates a gradual upward progression.

Variability: data range around line of best fit from a level 3.00 to 4.50.

Fluctuation around the mean (*SD* = 0.98).

Interpretation of Mrs. Jeffers' baseline measures are that pain levels vary from a level 3.00 to 5.00, it does not appear to have stabilized, making it difficult to predict future trend.

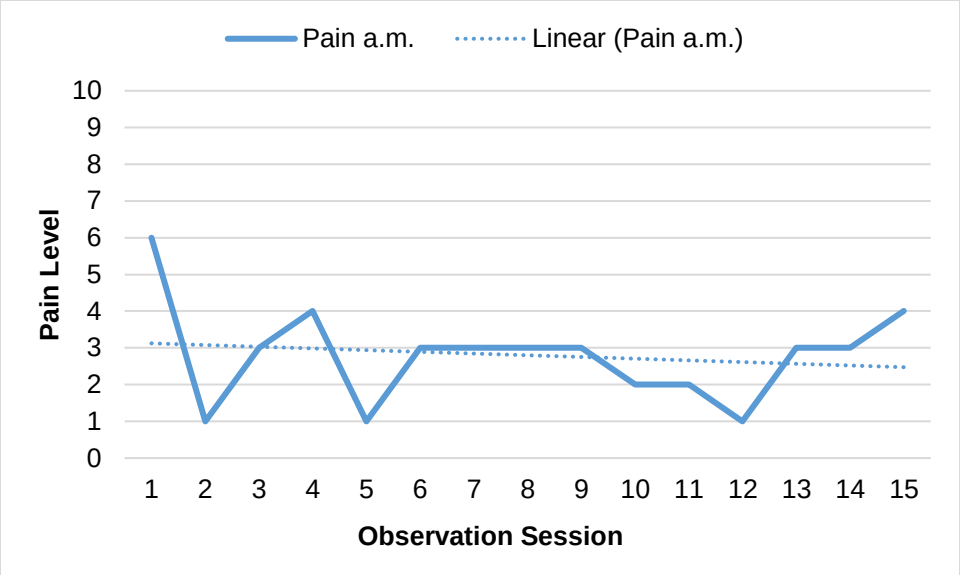

Figure 3.11. Mrs. Jeffers. Morning pain level measures.

Morning pain measures.

Level: mean of a. m. data (*M* = 2.80) perceived pain.

Trend: slope line of best fit indicates a slight downward progression.

Variability: data range around line of best fit from a level 3.00 to 2.50.

Fluctuation around the mean (*SD* = 1.32).

Comparison of Mrs. Jeffers' baseline and a. m. mean pain levels, her pain decreased from baseline to a. m. mean pain levels by (Δ = 2.80 - 3.83 = -1.03). This change in pain is meets the clinical minimum for the NPRS scale.

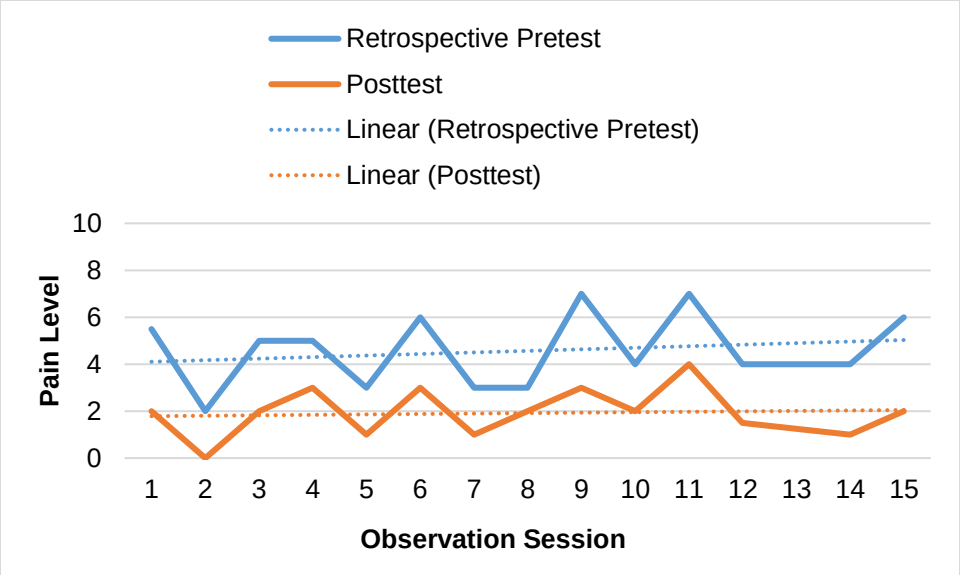

Figure 3.12. Mrs. Jeffers. Retrospective pretest to posttest pain measures.

Retrospective Pretest.

Level: mean of pretest data (*M* = 4.57) perceived pain.

Trend: slope line of best fit indicates a gradual upward progression.

Variability: data range around line of best fit from a level 4.00 to 5.00.

Fluctuation around the mean (*SD* = 1.52).

Posttest.

Level: mean of posttest data (*M* = 1.92) perceived pain.

Trend: slope line of best fit indicates a very slight upward progression.

Variability: data range around line of best fit 1.90 to 2.00.

Fluctuation around the mean (*SD* = 1.03).

The difference between Mrs. Jeffers' retrospective pretest and posttest measures indicate that perceived mean level of pain showed a positive decrease after engagement with the intervention ($\Delta = 1.92 - 4.57 = -2.65$). This change in pain is over the two point clinical difference of a (30%) change in pain intensity on the NPRS.

Ms. Pace. The following four tables display data from the measure instruments outlined above and are accompanied with comments related to the interpretation of Ms. Pace's data.

Table 3.18

Ms. Pace Senior Fitness Test Manual Scores

Test Item	Pretest Scores	Posttest Scores	Absolute Difference	Percent Change
Chair Stand in 30 Seconds	12	11	1	8.33%
Chair Reach to Touch Toes	2.25″	5.00″	2.75″	122%
Scratch the Back	1.00″	1.50″	0.50″	50%
Eight Foot Get Up Go	4.60 second (s)	4.80 s	0.20 s	4.35%

Comparing Ms. Pace's pretest scores with posttest scores. Chair stand test: she did one less stand on the posttest, indicating a decrease in lower body strength. Chair reach test: she reached farther past her toes on the posttest by 2.75 inches, indicating a significant increase in lower body flexibility. Scratch the back test: a change from pretest to posttest of 0.50 inch, indicating improvement in upper-body flexibility. Eight foot get up go test: posttest time was higher than pretest by 0.20 s, indicating a decrease in agility and dynamic balance.

Table 3.19

Ms. Pace AIMS2-SF Scores

Parameter	Retrospective Pretest Scores	Posttest Scores	Absolute Difference	Percent Change
Physical Function	0.00	0.00	0.00	N/C
Symptoms	0.83	0.00	-0.83	100.00%
Affect	0.00	0.00	0.00	N/C
Social Interaction	8.13	9.38	1.25	15.37%

Note: N/C stands for no change.

Comparison of Ms. Pace's scores indicate no change in perception of physical function and affect. There was a change in symptoms that went down from 0.83 to 0.00. Social interaction went up from 8.13 to 9.38. Interpretation of the scores indicate after participation

with the intervention, there was improvement in perceived symptoms, and no change in physical function or affect. Her score on social interaction went up during the study from 8.13 to 9.38. Because the intervention was instructed on an individual basis, social interaction was minimal and may account for the decrease of perceived social interaction.

Table 3.20

Ms. Pace New General Self-Efficacy Scale Scores

Retrospective Pretest Score	Posttest Score	Percent Change
40	40	0%

Comparison of Ms. Pace's NGSE scores indicate perception of general self-efficacy did not change. Interpretation of level of self-efficacy is that the scores were at the top of the NGSE scale and it remained stable throughout the study.

Table 3.21

Ms. Pace Pain Self-Efficacy Questionnaire Scores

Retrospective Pretest Score	Posttest Score	Percent Change
60	60	0%

Ms. Pace's retrospective pretest and posttest PSEQ scores did not change. There was no change in level of pain self-efficacy and it remained stable throughout the study. During the intervention, Ms. Pace's ability to stay with the study regardless of level of pain, was evidenced by not missing any treatment sessions and completion of study.

The following three figures display pain data from baseline, morning (a.m.), and retrospective pretest and posttest measures, respectively. Each figure is accompanied with comments related to the interpretation of the data.

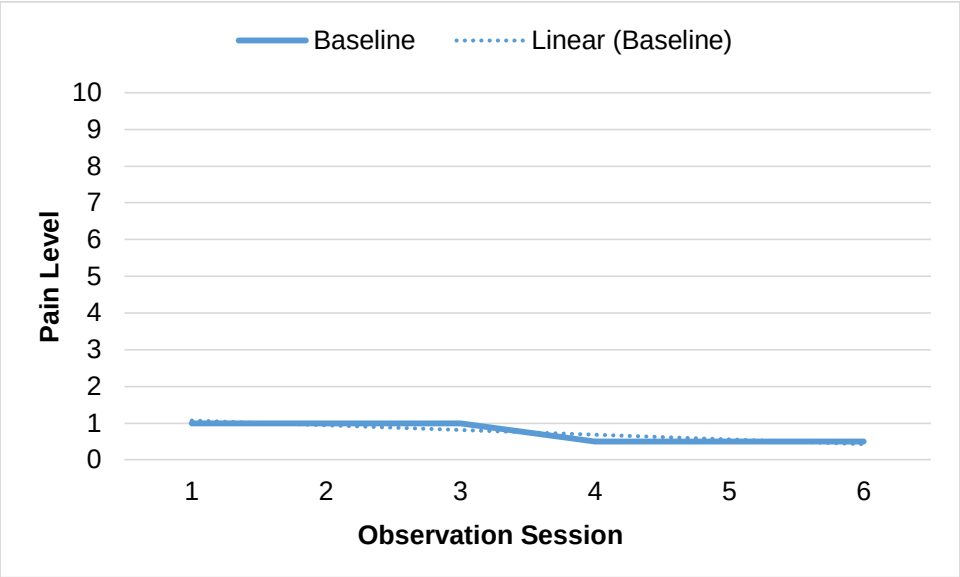

Figure 3.13. Ms. Pace. Baseline pain level measures.

Baseline pain measures.

Level: Mean of baseline data (*M* = 0.75) perceived pain.

Trend: Line of best fit slope indicates a gradual downward progression.

Variability: Data range around line of best fit from a level 1.00 to a level 0.50.

Fluctuation around the mean (*SD* = 0.27).

Interpretation of Ms. Pace's baseline pain levels are that levels had stabilized between a level 1.00 and 0.50.

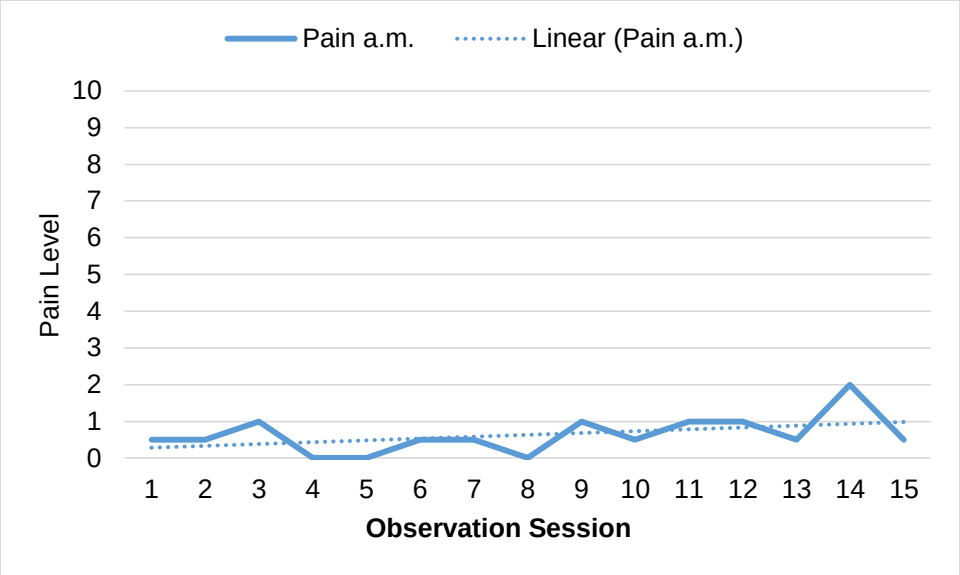

Figure 3.14. Ms. Pace. Morning pain level measures.

Morning pain measures.

Level: mean of a. m. data (M = 0.63) perceived pain.

Trend: slope line of best fit indicates a slight upward progression.

Variability: data range around line of best fit from a level 0.50 to a 1.00.

Fluctuation around the mean (SD = 0.52).

Comparison of Ms. Pace's baseline and a. m. means for pain, show there was a decrease in perceived pain over the course of the intervention ($\Delta = 0.63 - 0.75 = -0.12$).

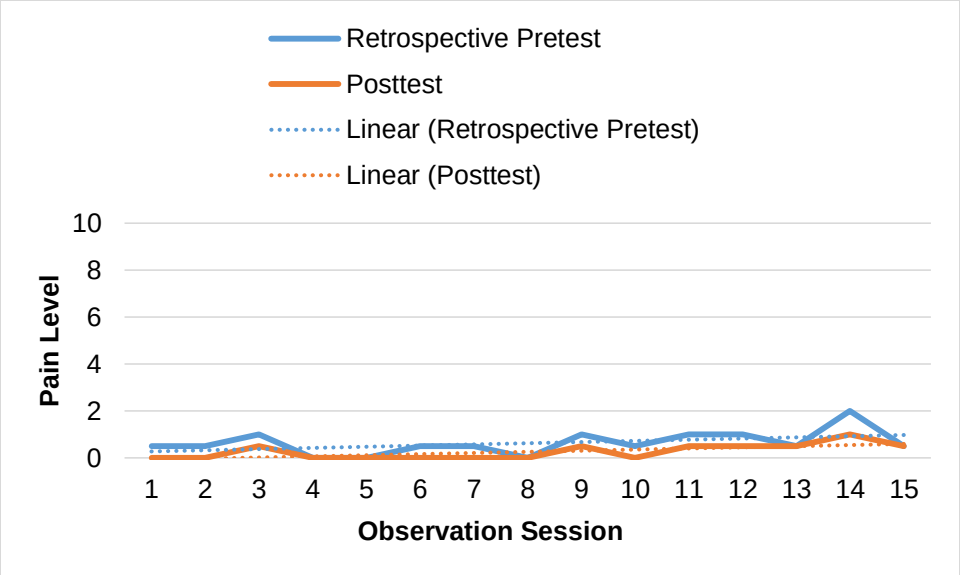

Figure 3.15. Ms. Pace. Retrospective pretest to posttest pain measures.

Retrospective Pretest.

Level: mean of pretest data (*M* = 0.63) perceived pain.

Trend: slope line of best fit indicates a slight upward progression.

Variability: data range around line of best fit from a level 0.50 pain to 1.00.

Fluctuation around the mean (*SD* = 0.52).

Posttest.

Level: mean of posttest data (*M* = 0.27) perceived pain.

Trend: slope line of best fit indicates a slight upward progression.

Variability: data range around line of best fit from between a level 0.00 to 0.50.

Fluctuation around the mean (*SD* = 0.32).

Interpretation of the comparison of Ms. Pace's retrospective pretest and posttest perceived levels of pain indicate a decrease after engagement with the intervention ($\Delta = 0.27 - 0.63 = -0.36$).

Mrs. Sage. The following four tables display data from the measure instruments outlined above and are accompanied with comments related to the interpretation of Mrs. Sage's data.

Table 3.22

Mrs. Sage Senior Fitness Test Manual Scores

Test Item	Pretest Scores	Posttest Scores	Absolute Difference	Percent Change
Thirty Second Chair Stand	12	15	3	25%
Chair Reach to Touch Toes	1.50″	2.50″	1.00″	67%
Scratch the Back	-7.00″	-6.50″	0.50″	7.14%
Eight Foot Get Up Go	4.30 second (s)	3.80 s	0.50 s	11.63%

Comparing Mrs. Sage's scores. Chair stand test: she did three more stands posttest, indicating an improvement in lower body strength performance. Chair reach test: she reached farther on posttest by 1.00 inch, indicating improvement in lower body flexibility. Scratch the back test: there was close in the gap between fingertips by 0.50 inch, indicating improvement in upper-body flexibility. Eight foot get up go test: she lowered amount of time by 0.50 s, indicating improvement in agility and dynamic balance. Indicating improvement in perceived well-being in all measures.

Table 3.23

Mrs. Sage AIMS2-SF Scores

Parameter	Retrospective Pretest Scores	Posttest Scores	Absolute Difference	Percent Change
Physical Function	1.46	1.88	0.42	28.76%
Symptoms	5.00	5.00	0.00	N/C
Affect	6.00	5.00	-1.00	16.66%
Social Interaction	7.50	7.50	0.00	N/C

Note: N/C stands for no change.

Comparison of Mrs. Sage's scores indicate a decrease in perceived physical function, up from 1.46 to 1.88. A positive change in affect going down from 6.00 to 5.00. No change in symptoms, or social interaction.

Table 3.24

Mrs. Sage New General Self-Efficacy Scale Scores

Retrospective Pretest Score	Posttest Score	Percent Change
31	29	6.45%

Comparison of Mrs. Sage's scores indicate that perception of level of self-efficacy went down from a 31 (average range = 27 to 31), to a 29 during the study.

Table 3.25

Mrs. Sage Pain Self-Efficacy Questionnaire Scores

Retrospective Pretest Score	Posttest Score	Percent Change
50	50	0%

Comparison of Mrs. Sage's scores show no change. During the intervention, Mrs. Sage's ability to stay with the study regardless of her level of pain, was evidenced by not missing any treatment sessions and completing the study.

The following three figures display pain data from baseline, morning (a.m.), and retrospective pretest and posttest measures, respectively. Each figure is accompanied with comments related to the interpretation of the data.

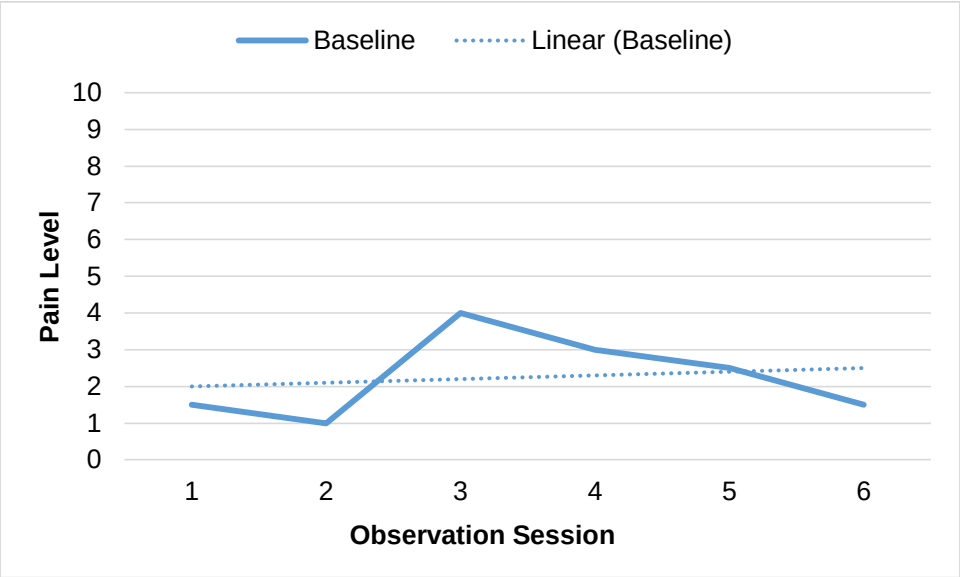

Figure 3.16. Mrs. Sage. Baseline pain level measures.

Baseline pain measures.

Level: mean of baseline data (*M* = 2.25) perceived pain.

Trend: slope line of best fit indicates a slight gradual upward progression.

Variability: data range around line of best fit from a level 2.00 to a level 2.50.

Fluctuation around the mean (*SD* = 1.13).

Interpretation of Mrs. Sage's baseline pain measures show they had not stabilized, making it difficult to predict a future trend.

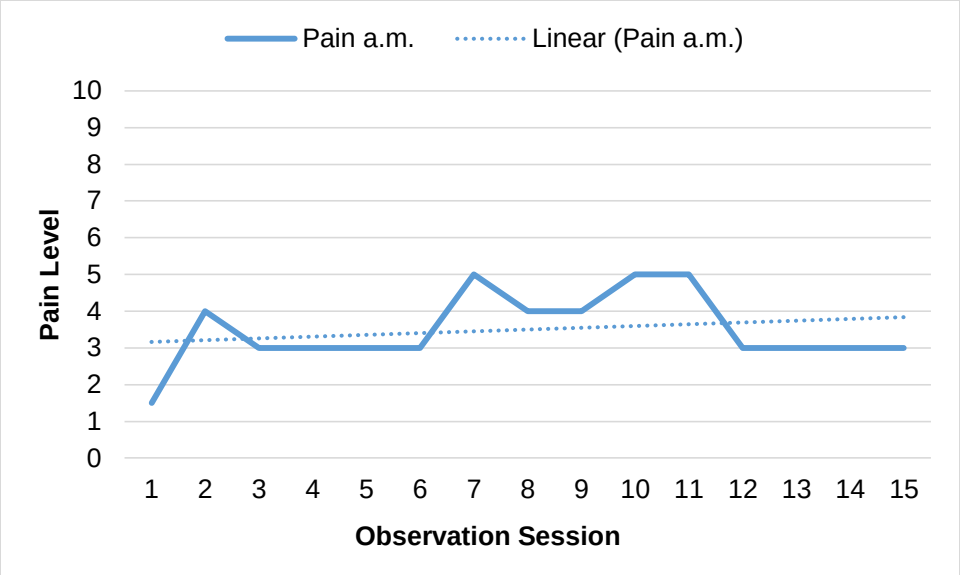

Figure 3.17. Mrs. Sage. Morning pain level measures.

Morning pain measures.

Level: mean of a. m. data (*M* = 3.50) perceived pain.

Trend: slope line of best fit indicates an upward progression.

Variability: data range around line of best fit from a level 3.00 to a 4.00.

Fluctuation around the mean (*SD* = 0.98).

Comparing the mean levels of pain from Mrs. Sage's baseline and a.m. measures, perceived mean level of pain went up during the intervention ($\Delta = 3.50 - 2.25 = 1.25$).

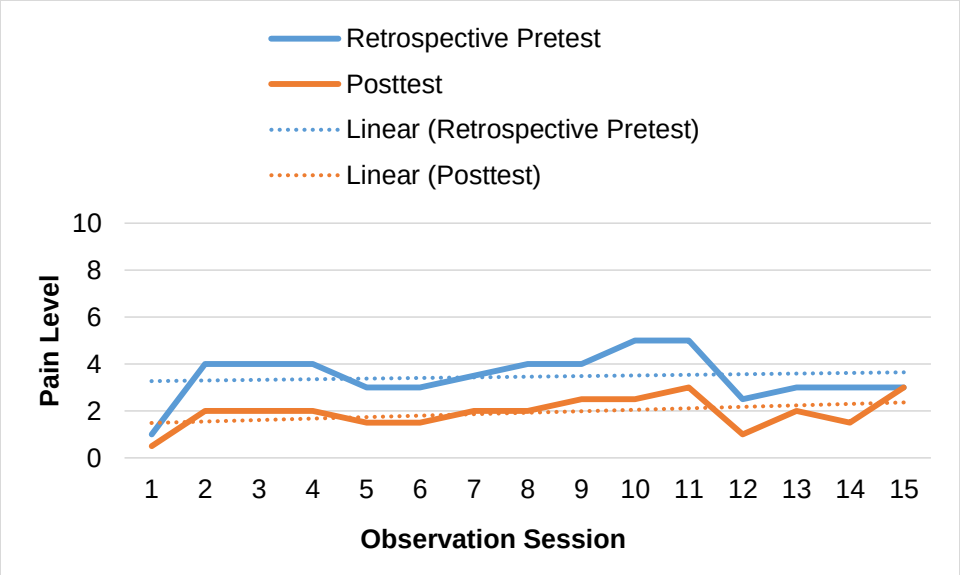

Figure 3.18. Mrs. Sage. Retrospective pretest to posttest pain measures.

Retrospective Pretest.

Level: mean of pretest data (*M* = 3.47) perceived pain.

Trend: slope line of best fit indicates a slight gradual upward progression.

Variability: data range around line of best fit from a level 3.20 to 3.60.

Fluctuation around the mean (*SD* = 1.01).

Posttest.

Level: mean of posttest data (*M* = 1.93) perceived pain.

Trend: slope line of best fit indicates a slight upward progression.

Variability: data range around line of best fit 1.50 to 2.30. Fluctuation around the mean (*SD* = 0.68).

Interpretation of the comparison of Mrs. Sage's retrospective pretest and posttest measures indicate that her level of pain showed a decrease after engagement with the intervention ($\Delta = 1.93 - 3.47 = -1.54$). This change in pain is over the one point clinical minimal (15%) change in pain level on the NPRS scale.

AB case-pair pain data. The following three figures, were generated by the ExPRT 2.0 AB statistical program for graphical line depictions of the effect of the two treatments on participant perceived pain. The (y) axis numerical scale goes from -10 to 0 to 10, a negative number indicates a positive effect (less pain) of treatment, and a positive number reflects a negative effect of treatment (more pain).

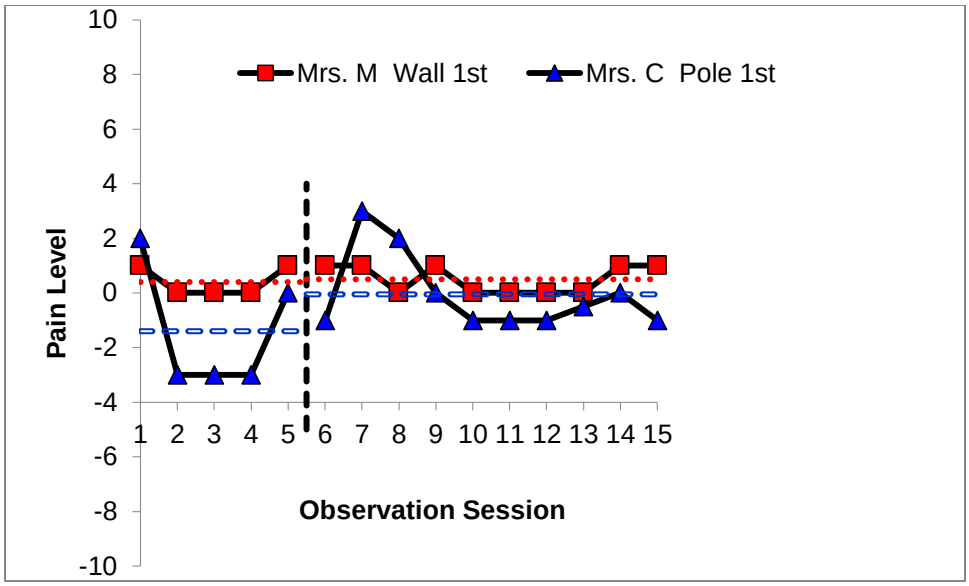

Figure 3.19. ExPRT case-pair 1 pain levels. Figure shows simultaneous crossover at session 6.

Visual analysis of case-pair 1.

Mrs. Messina.

Level: A treatment = (*M* = 0.40), B treatment = (*M* = 0.50) perceived pain.

Trend: slope line of best fit shows a slight rise from A to B by 0.10 point.

Variability: A treatment (*SD* = 0.547), B treatment (*SD* = 0.527).

Comparison of Mrs. Messina's pre-crossover mean pain level (*M* = 0.40), and post-crossover mean pain level (*M* = 0.50) showing increase in pain after crossover to the pole. Indicating pain was higher during engagement with the pole treatment by 0.10 point.

Mrs. Calloway.

Level: B treatment = (*M* = -1.40), A treatment = (*M* = -0.50) perceived pain.

Trend: slope line of best fit shows a rise from B to A by 0.90 point.

Variability: B treatment (*SD* = 2.302), A treatment (*SD* = 1.423).

Comparison of Mrs. Calloway's pre-crossover mean pain level (*M* = -1.40), and post-crossover mean pain level (*M* = -0.50) shows that pain increased after crossover to the wall. Indicating that pain levels were lower during engagement with the pole by 0.90 point.

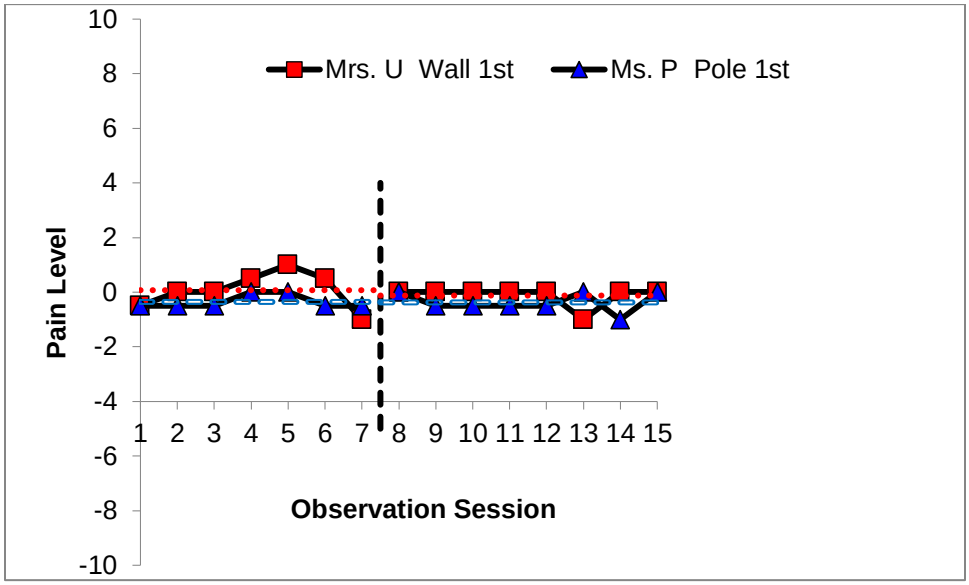

Figure 3.20. ExPRT case-pair 2 pain levels. Figure shows simultaneous crossover at session 8.

Visual analysis of case-pair 2.

Mrs. Ulrich.

Level: A treatment = (*M* = 0.07), B treatment = (*M* = -0.13) perceived pain.

Trend: slope line of best fit indicates going down from A to B by -0.20 point.

Variability: A treatment (*SD* = 0.673), B treatment (*SD* = 0.354).

Comparison of Mrs. Ulrich's pre-crossover mean pain level (*M* = 0.07), and post-crossover mean pain level (*M* = -0.13) show that pain decreased after crossover to the pole. Indicating that pain went down during engagement with the pole treatment by -0.20 point.

Ms. Pace.

Level: B treatment = (*M* = -0.36), A treatment = (*M* = -0.38) perceived pain.

Trend: slope line of best fit from B to A going down by -0.02 point.

Variability: B treatment (*SD* = 0.244), A treatment (*SD* = 0.354).

Comparison of Ms. Pace's pre-crossover mean pain level (*M* = -0.36), and post-crossover mean pain level (*M* = -0.38) show that pain decreased after crossover to the wall, indicating pain was higher during engagement with the pole treatment by -0.02 point.

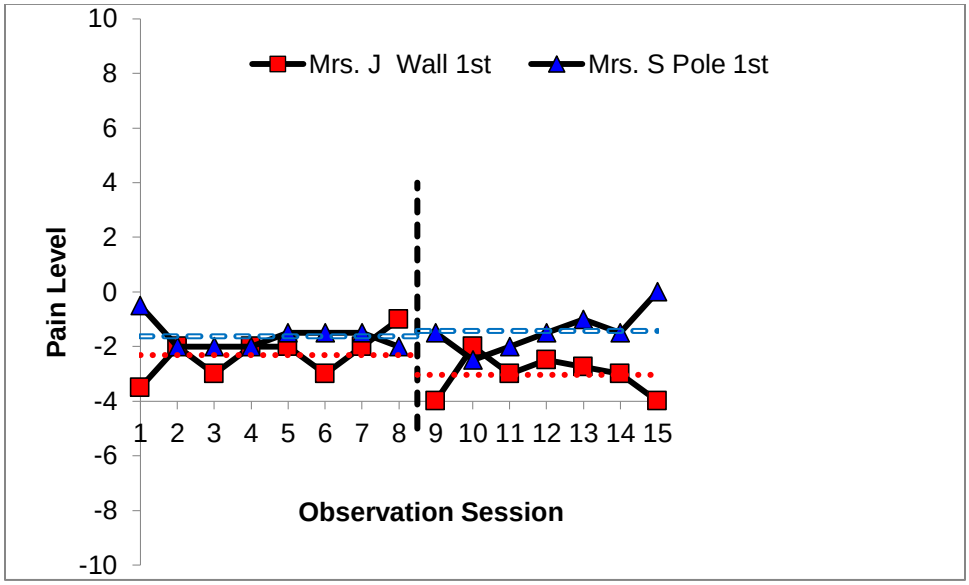

Figure 3.21. ExPRT case-pair 3 pain levels. Figure shows simultaneous crossover at session 9.

Visual analysis of case-pair 3.

Mrs. Jeffers.

Level: A treatment = (*M* = -2.31), B treatment = (*M* = -3.04) perceived pain.

Trend: slope line of best fit shows a decrease in pain level from A to B by -0.73 point.

Variability: A treatment (*SD* = 0.799), B treatment (*SD* = 0.742).

Comparison of Mrs. Jeffers's pre-crossover pain level (*M* = -2.31), and post-crossover pain level (*M* =-3.04) shows that pain decreased after crossover to the pole. Indicating level of pain was lower during engagement with the pole treatment by -0.73 point.

Mrs. Sage.

Level: B treatment = (*M* = -1.63), A treatment = (*M* = -1.43) perceived pain.

Trend: slope line of best fit indicates a rise from B to A by 0.20 point.

Variability: B treatment (*SD* = 0.517), A treatment (*SD* = 0.787).

Comparison of Mrs. Sage's pre-crossover mean pain level (*M* = -1.63), and post-crossover mean pain level (*M* = -1.43) show that pain increased after crossover to the wall. Indicating pain level was lower during engagement with the pole by 0.20 point.

Juxtaposition of participant primary data. The following 12 figures graphically depict the juxtaposition of participant primary data collected from the measures on pain, the Senior Fitness Manual tests, the AIMS-SF tests, the NGSE questionnaire, and the PSEQ.

Pain data.

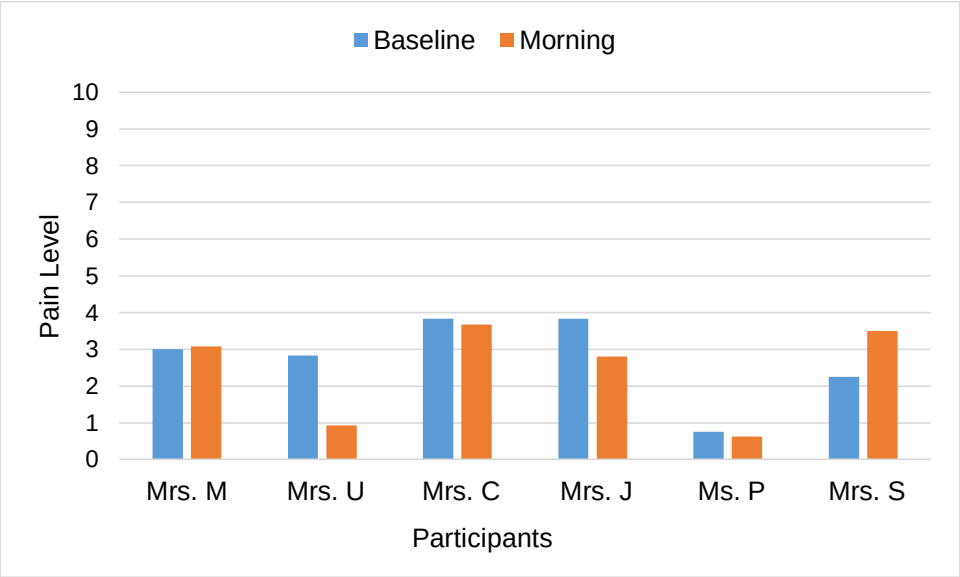

Figure 3.22. Comparison baseline and morning mean pain levels. This figure depicts participant baseline score means juxtaposed to morning score means for comparison.

Four participants had a lower score on morning pain by the following percentages: Mrs. Ulrich: (67.14%), Mrs. Calloway: (4.18%), Mrs. Jeffers: (26.90%), Ms. Pace: (16.00%), two participants had a higher score: Mrs. Messina: (2.33%), Mrs. Sage: (55.56%).

The mean of the six baseline scores (M = 2.75), and the mean of the six a.m. scores (M = 2.43). The difference between baseline and a.m. measures 2.75 – 2.43 = 0.32, indicates that there was an average decrease in perceived pain by 0.32 point during the intervention.

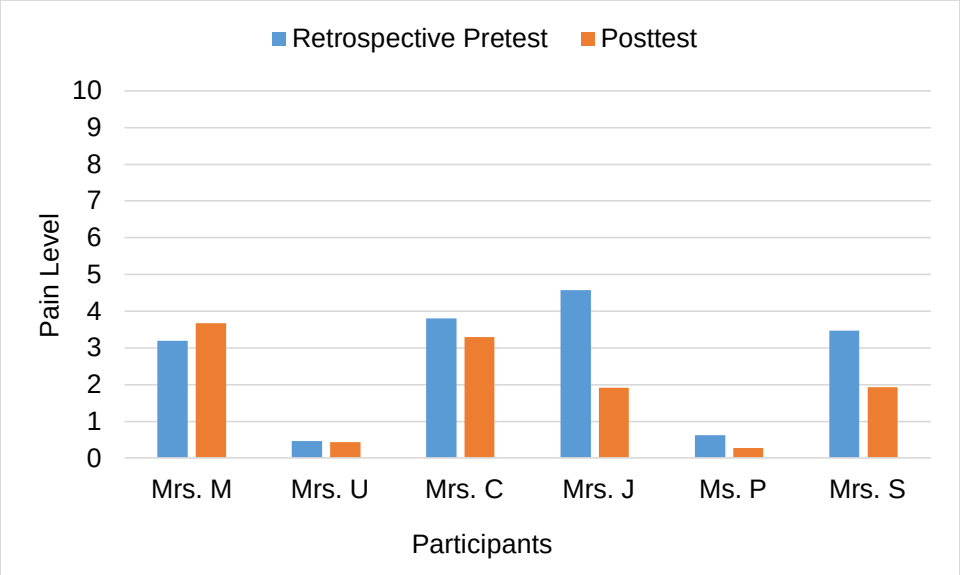

Figure 3.23. Comparison retrospective pretest and posttest mean pain levels. This figure depicts participant retrospective pretest pain score means juxtaposed to posttest pain score means for comparison.

Five participants had a lower score on posttest by the following percentages: Mrs. Ulrich: (8.51%), Mrs. Calloway: (13.16%), Mrs. Jeffers: (58.00%), Ms. Pace: (57.14%), Mrs. Sage: (44.38%), one participant had a higher score on posttest: Mrs. Messina: (14.69%).

The mean of the retrospective pretest means (M = 2.69), and the mean of the posttest means (M = 1.92). The difference between retrospective pretest and posttest means 1.92 – 2.69 = -0.77, indicates at posttest, participant average pain decreased by -0.77 point.

Senior fitness manual test data. Each of the following four figures graphically illustrate participant pretest scores compared to posttest scores from the Senior Fitness Manual tests.

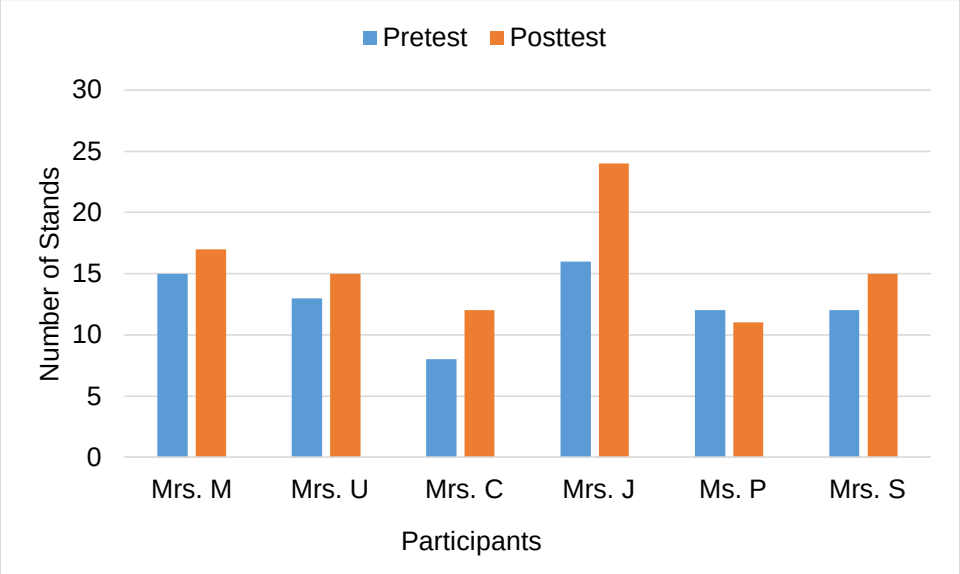

Figure 3.24. Chair stand in 30 seconds test scores. This figure depicts participant pretest scores juxtaposed to their posttest scores for amount of times standing from a seated position in 30 seconds.

Five participants had an increase in the amount of stands performed at posttest: Mrs. Messina: (13.33%), Mrs. Ulrich: (15.38%), Mrs. Calloway: (50%), Mrs. Jeffers: (50%), Mrs. Sage: (25%), one participant had a decrease in stands: Ms. Pace: (8.33%).

The mean of the pretest scores (M = 12.67), and the mean of the posttest scores (M = 15.67). The difference between pretest and posttest means 15.67 - 12.67 = 3.00, indicates at posttest, average participant increase in performance in lower body strength by 3.00 stands.

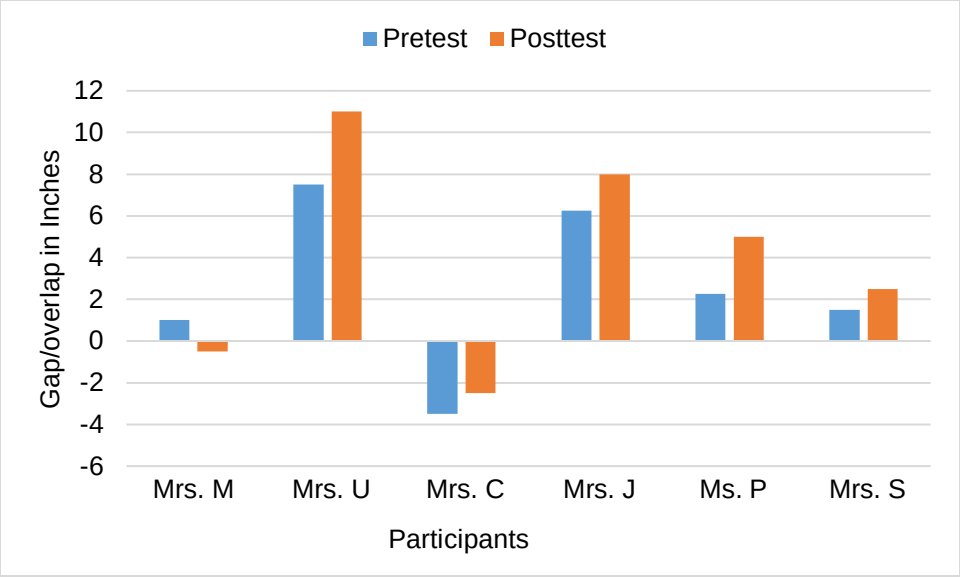

Figure 3.25. Chair reach to touch toes test scores. This figure depicts participant pretest scores juxtaposed to posttest scores for touching toes while seated. A negative number is a gap between fingers and toes, a positive number is an overlap of fingers past toes.

Five participants showed improvement in posttest scores: Mrs. Ulrich: (46.66%), Mrs. Calloway: (28.57%), Mrs. Jeffers: (28%), Ms. Pace: (122%), Mrs. Sage: (67%), and one participant had a decline: Mrs. Messina: (150%).

The mean of the pretest scores (M = 2.50″), and the mean of the posttest scores (M = 3.92″). The difference between pretest and posttest measures 2.50″ – 3.92″ = -1.42″, indicates at posttest, an average improvement in lower body flexibility by 1.42 inches.

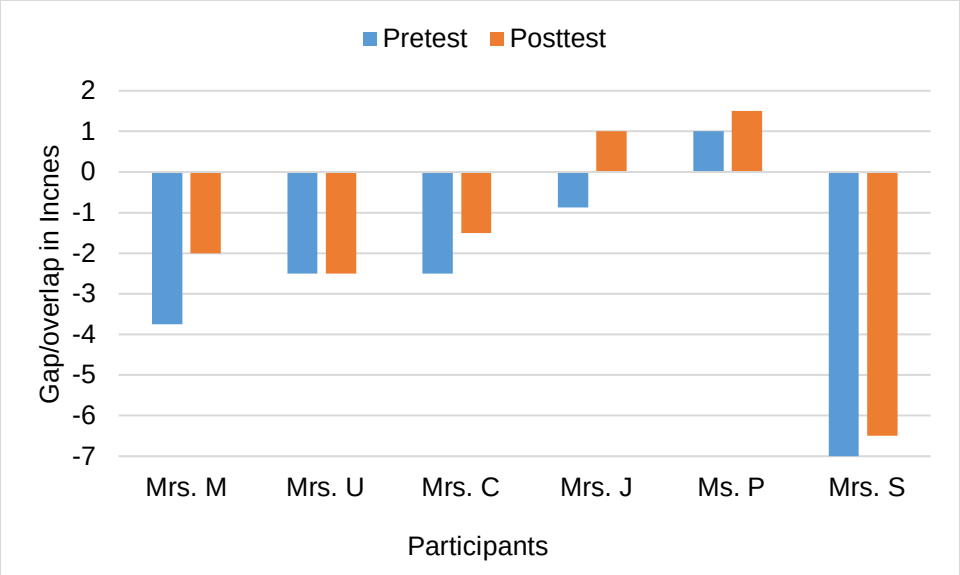

Figure 3.26. Scratch the back test scores. This figure depicts the juxtaposition of pretest and posttest scores for reaching behind the back to touch fingertips of both hands. A negative number is a gap between fingertips, a positive number is an overlap of fingers.

Five participants showed an improvement in their posttest scores: Mrs. Messina: (47.70%), Mrs. Calloway: (40%), Mrs. Jeffers: (214.30%), Ms. Pace: (50%), Mrs. Sage: (7.14%) one participant had no change in performance: Mrs. Ulrich: (0.0%).

The mean of pretest scores (M = -2.60″), and mean of posttest scores (M = -1.67″). The difference between pretest and posttest measures -1.67″ – -2.60″ = 0.93″, indicates at posttest an average improvement in upper body flexibility by 0.93 inch.

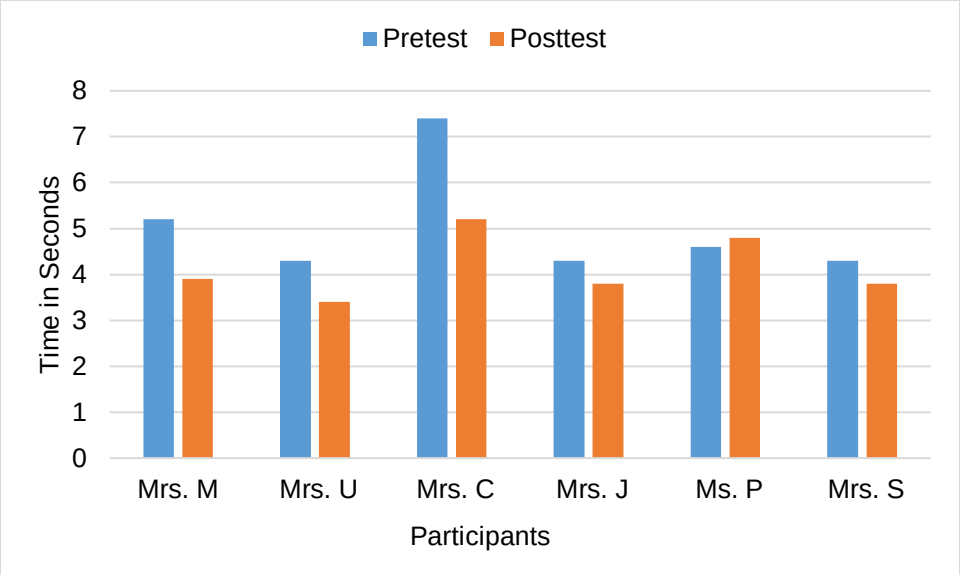

Figure 3.27. Eight foot get up go test scores. This figure depicts the juxtaposition of pretest and posttest scores for the amount of seconds it takes to get up from a chair, go around a marker, and return to the chair.

Five participants showed an improvement in their posttest scores: Mrs. Messina: (25%), Mrs. Ulrich: (21%), Mrs. Calloway: (29.72%), Mrs. Jeffers: (11.63%), Mrs. Sage: (11.63%), one participant had a decline in their posttest score: Ms. Pace: (4.35%).

The mean of pretest scores (M = 5.02 s), and mean of the posttest scores (M = 4.15 s). The difference between pretest and posttest measures 5.02 – 4.15 = 0.87 s, at posttest average participant improvement in time by 0.87 s, indicating improvement in dynamic balance and agility.

AIMS2-SF data. Each of the following four figures graphically illustrate participant retrospective pretest scores compared to posttest scores from the AIMS2-SF tests. The lower the score the higher perception of well-being on each scale.

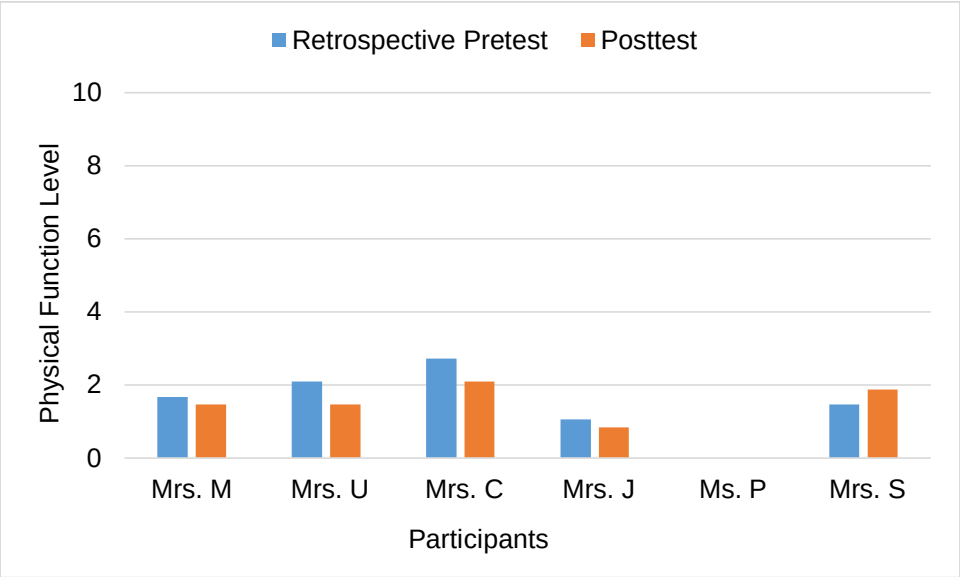

Figure 3.28. AIMS2-SF physical function test scores. This figure depicts participant retrospective pretest scores juxtaposed to posttest scores for perceived level of physical function.

Four participants had a lower score on posttest by the following percentages: Mrs. Messina: (12.57%), Mrs. Ulrich: (30.14%), Mrs. Calloway: (23.16%), Mrs. Jeffers: (20.00%), one participant had a higher score: Mrs. Sage: (28.76%), and one participant had a score of zero on both the retrospective pretest and posttest: Ms. Pace: (0.0%).

The mean of the retrospective pretest scores (M = 1.50), and the mean of the posttest scores (M = 1.29). The difference between retrospective pretest and posttest means 1.29 – 1.50 = -0.21, shows average improvement on well-being of physical function at posttest of 0.21 point.

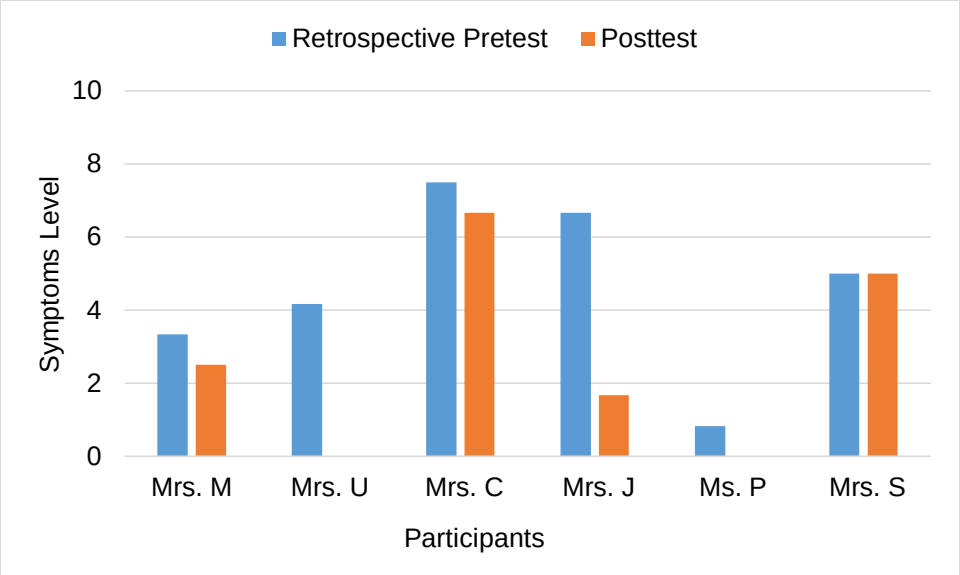

Figure 3.29. AIMS2-SF symptoms test scores. This figure depicts participant retrospective pretest scores juxtaposed to posttest scores for perceived level of symptoms.

Five participants had a lower score on posttest by the following percentages: Mrs. Messina: (24.92%), Mrs. Ulrich: (100%), Mrs. Calloway: (11.20%), Mrs. Jeffers: (74.92%), Ms. Pace: (100%), and one participant had no change in scores Mrs. Sage: (0.0%).

The mean of the retrospective pretest scores (M = 4.58), and the mean of the posttest scores (M = 2.64). The difference between retrospective pretest and posttest means (2.64 – 4.58 = -1.94), shows an average improvement on perceived symptoms at posttest of 1.94 points.

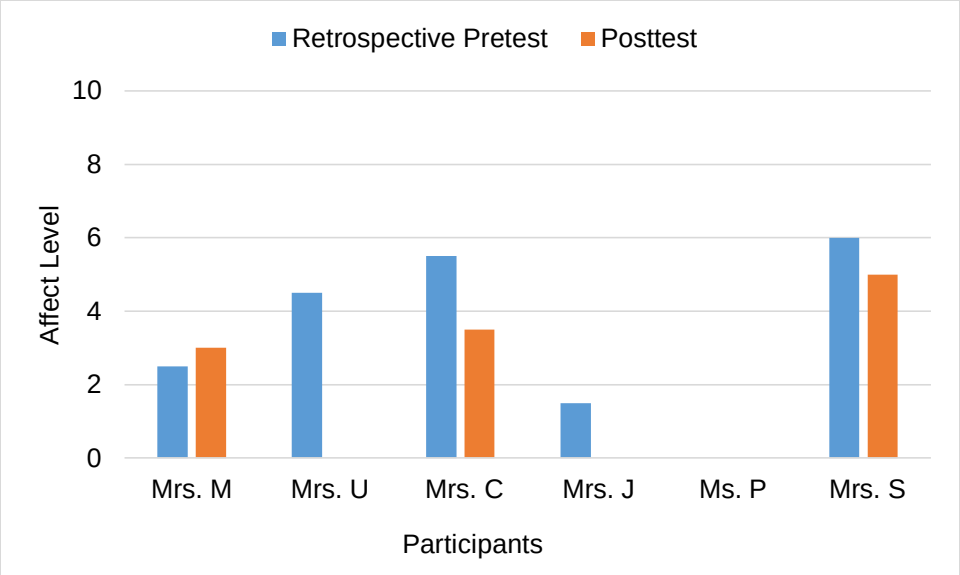

Figure 3.30. AIMS2-SF affect test scores. This figure depicts participant retrospective pretest scores juxtaposed to posttest scores for perceived level of affect.

Four participants had a lower score on posttest by the following percentages: Mrs. Ulrich: (100%), Mrs. Calloway: (36.36%), Mrs. Jeffers: (100%), Mrs. Sage: (16.66%); one participant had a higher score: Mrs. Messina: (20.00%), and one participant had a score of zero on both the retrospective pretest and posttest Ms. Pace: (0.0%).

The mean of the retrospective pretest scores (M = 3.33), and the mean of the posttest scores (M = 1.92). The difference between retrospective pretest and posttest (1.92 – 3.33 = -1.41), shows an average improvement on perceived affect at posttest of 1.41 points.

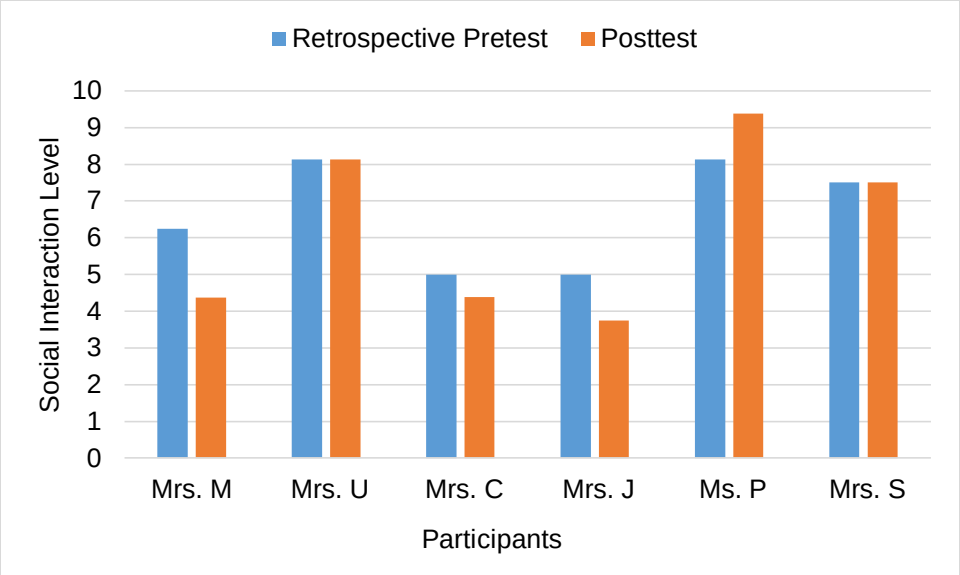

Figure 3.31. AIMS2-SF social interaction test scores. This figure depicts participant retrospective pretest scores juxtaposed to posttest scores for perceived level of social interaction.

Three participants had a lower score on posttest by the following percentages: Mrs. Messina: (30.08%), Mrs. Calloway: (12.40%), Mrs. Jeffers: (25.00%), two participants had no change in scores: Mrs. Ulrich: (0.0%), and Mrs. Sage: (0.0%), and one participant had a higher posttest score: Ms. Pace: (15.37%).

The mean of the retrospective pretest scores (M = 6.67), and the mean of the posttest scores (M = 6.25). The difference between retrospective pretest and posttest measures 6.25 – 6.67 = -0.42, shows an average improvement on social relations at posttest of 0.42 point.

Ranking of the four AIMS2-SF scales indicate at posttest, the largest positive affect on well-being was symptoms (M = 1.94); followed by affect (M = 1.41); social relations (M = 0.42); and physical function (M = 0.21).

NGSE data.

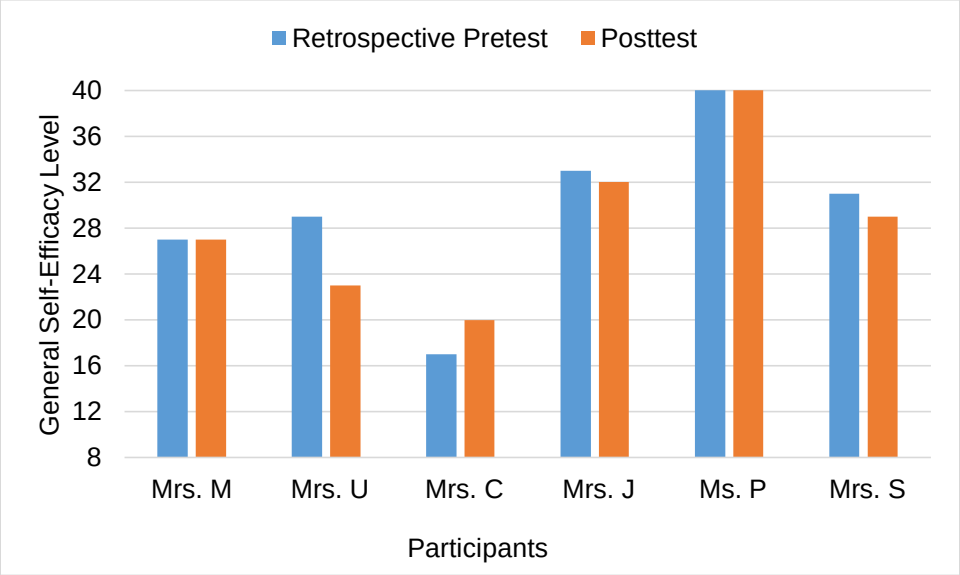

Figure 3.32. New general self-efficacy scale test scores. This figure depicts participant retrospective pretest scores juxtaposed to posttest scores for comparison. A higher score equals a higher perception of general self-efficacy.

One participant had a higher score on posttest: Mrs. Calloway: (17.65%), three participants had a lower score on posttest by the following percentages: Mrs. Ulrich: (20.69%), Mrs. Jeffers: (3.03%), and Mrs. Sage: (6.45%), and two participants had no change: Mrs. Messina: (0. 0%), and Ms. Pace: (0.0%).

The mean of the retrospective pretest scores (M = 29.50), and the mean of the posttest scores (M = 28.50). The difference between retrospective pretest and posttest means 28.50 – 29.50 = -1.00, shows an average decrease of general self-efficacy at posttest of 1.00 point.

PSEQ data.

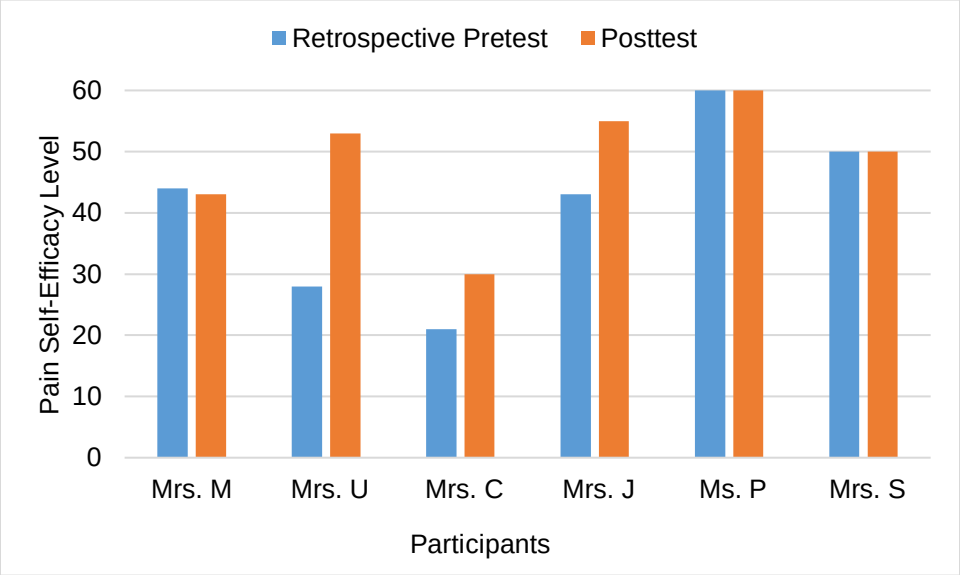

Figure 3.33. Pain self-efficacy questionnaire test scores. This figure depicts participant retrospective pretest scores juxtaposed to posttest scores for comparison. A higher score equals a higher perception of pain self-efficacy.

Three participants had higher scores on posttest by the following percentages: Mrs. Ulrich: (89.29%), Mrs. Calloway: (42.86%), and Mrs. Jeffers: (27.91%), one participant had a lower score on posttest: Mrs. Messina: (2.27%), and two participants had no change: Ms. Pace: (0.0%), Mrs. Sage: (0.0%).

The mean of the retrospective pretest scores (M = 41.00), and the mean of the posttest scores (M = 48.50). The difference between retrospective pretest and posttest 48.50 – 41.00 = 7.50, shows an average improvement on pain self-efficacy at posttest of 7.50 points.

Data Analysis

Visual analysis of data. Single-case research has customarily depended on the visual assessment of the collected, then graphed data, to decide if there exists evidence of a relationship between the dependent and independent variables, at the same time, to determine the magnitude or strength of the relationship if one exists (T. R. Kratochwill et al., 2010). The study used visual assessment of the data expressed in graphs following established protocol to analyze how consistent the patterns of the data points are in relation to their variability, trend, and level of the effect of the intervention on the dependent variables. The reasons for the study to rely on visual analysis is: (a) most single-case research has used visual data analyzation for interpretation of outcome measures; (b) there is no general agreement on the standards to be used to statistically analyze the data; and, (c) there is no substantial agreement on the proper method to calculate single-case study effect size (Kratochwill et al., 2013).

ExPRT AB 2.0 (*Excel*® *Package of Randomization Tests*). The ExPRT 2.0 AB single-case data analysis program has the specific capability to analyze data from the single-case crossover method used for the study (Levin, 2014). Pain level was repeatedly measured and recorded for the establishment of baseline pain levels, morning (a. m.) pre-session pain levels, and retrospective pretest and posttest pain levels. The data of interest and ExPRT analysis were the pain levels collected from each post-intervention session, i.e. the retrospective pretests and posttests. Only the graphs depicting case-pair pre and post crossover data and the randomized crossover point were used. This is because the way that the investigator designed the intervention of having each participant within each case pair begin with different treatments and then simultaneously switch to the opposite treatment that each participant began with, was not in accordance with the ExPRT 2.0 AB permutation procedure. For the ExPRT program to properly

analyze the data, each case pair of participants would have to have started with the same treatment and then crossed over to the same opposite treatment. This did not affect the graphical display of the differenced pain data, the randomized crossover point, nor the generated means; however the *p* value and ranking of the permutations of the analysis were incorrect, and thus not used for data analysis of the study.

Inter-rater agreement. Visual analysis of the ExPRT graphs were independently conducted then recorded on Microsoft Excel 2013 sheets by the investigator and data analysis assistant Matt Hanauer. Comparison of the two sets of data for inter-rater agreement was performed with the R package software (Revelle, 2017). The outcome from R analysis was a Cohen's Kappa = (0.67), [95% CI of (.32 to 1)]. This is the relative amount of agreement above an agreement by chance. A score of (0.67) is identified as within the "considerable" agreement range (0.61 – 0.80):(Landis & Koch, 1977). Matt Hanauer is a graduate student in the School of Education at a large Midwestern university. He is currently working with Dr. John Hitchcock the director of the Center for Evaluation & Education Policy (CEEP), on authoring an article on single-case design data analysis. Matt is also working on publishing an article on the issue of missing data within the single-case design, due to his involvement with this study.

Missing data. Of the six participants, one participant was absent two sessions and one participant was absent one session. For a total of three missing data cells in the Excel 2013 data sheets. The following procedure explains how the missing data were estimated. The numbers from before and after each blank data cell were added together. The sum of the two numbers were then divided by two to get the quotient. The quotient was then entered into the blank cell to replace the missing data.

Differenced pain data. For the analysis of the data from the intervention, a single-tailed positive directional hypothesis test was chosen at a significance level of ($\alpha = 0.05$). It was predicted that the B phase mean would be larger than the A phase mean. The differences of the B – A intervention pain measures for each participant, were obtained using the Microsoft Excel 2013 program. These data sets, were entered into the ExPRT 2.0 AB program in each respective participant's case-pair to generate graphs of the effect of the two treatments on participant pain.

Sensitivity analyses. For a sensitivity data analysis, a mixed-model for repeated measures procedure was conducted with the use of the Statistical Analysis System (SAS®, 9.4.) software (*The sensitivity data analysis for this study was generated using SAS 9.4 software*. *Copyright © 2015, SAS Institute Inc. SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc., Cary NC, USA*), in which the pain scores were modeled as the dependent variable and pretest-posttest time as the indicators of treatment and main exposure variables. The procedure was adjusted for education, age, marital status, BMI, prior participation in a water exercise program, and surgery to the lower extremity. Also, to determine whether the means change from retrospective pretest to posttest values, all of the A posttest minus pretest scores (n = 45) were pooled, and all of the B posttest minus pretest scores (n = 45) were pooled. A paired t-test was then conducted using Microsoft Excel 2013, to compare the means of the two pooled A and B treatment scores.

Primary data analysis. Primary data were entered into the Microsoft Excel 2013 program to generate graphical representations of the juxtaposition of: baseline and morning pain levels; retrospective pretest and posttest pain levels; pretest and posttest scores on lower body strength, lower and upper flexibility, agility and dynamic balance; perceived well-being of

physical function, symptoms, affect, and social interaction; general self-efficacy; and pain self-efficacy; for comparison.

Results

ExPRT case-pair pain data.

Case-pair 1. Mrs. Messina started with the wall, her mean pain level went up when engaged with the pole treatment by 0.10 point. Her pain was lower during the wall condition. Mrs. Calloway started with the pole, her mean pain level went up when engaged with the wall treatment by 1.35 points. Her perceived pain was lower during the pole condition.

Case-pair 2. Mrs. Ulrich started with the wall, her mean pain level went down when engaged with the pole treatment by 0.20 point. Her pain was lower during the pole condition. Ms. Pace started with the pole, her mean pain level went down when engaged with the wall treatment by 0.02 point. Her pain was lower during the wall condition.

Case-pair 3. Mrs. Jeffers started with the wall, her mean pain level went down when engaged with the pole treatment by 0.73 point. Her pain was lower during the pole condition. Ms. Sage started with the pole, her mean pain level went up when engaged with the wall treatment by 0.20 point. Her pain was lower during the pole condition.

Sensitivity Analyses. Among the six participants, there was no statistically significant difference in pain scores comparing post treatment to pretreatment; holding education, age, marital status, BMI, prior participation in a water exercise program, and surgery to the lower extremity constant; $\beta = -0.52$, $p = 0.344$. A paired *t*-test was performed to determine whether the change in mean values from pretest to posttest were different for the A compared to the B treatment differenced scores. There was no significant difference in the means between the two treatments; $t(44) = 1.03$, $p = 0.310$.

Mrs. Messina. Senior Fitness Manual tests: improved lower body strength (13.33%), diminished lower body flexibility (150%), improved upper body flexibility (47.70%), improved agility and dynamic balance (25%). AIMS2-SF: improved perceived physical function (12.57%), symptoms (24.92%), and social interaction (30.08%), decrease in affect (20.00%). NGSE: no change (0.0%). PSEQ: change from (44 to 43) down (2.27%). Difference between baseline and a.m. pain: increase in pain by 0.07 point. Difference of retrospective pretest and posttest: pain increased at posttest 0.47 point.

Mrs. Ulrich. Senior Fitness Tests: improved lower body strength (15.38%), improved lower body flexibility (47%), no change in upper body flexibility (0.0%), improved agility and dynamic balance (21%). AIMS2-SF: improved perceived physical function (30.14%), symptoms (100%), and affect (100%), social interaction: no change (0.00%). NGSE: decrease from (29 to 23), change (20.69%). PSEQ: Increase from (28 to 53), change (89.29%). Difference between baseline and a.m. pain: decrease in pain by 1.90 points. Difference of retrospective pretest and posttest: pain decreased at posttest by 0.04 point.

Mrs. Calloway. Senior Fitness Manual tests: improved lower body strength (50.00%), improved lower body flexibility (44%), improved body flexibility (40%), improved agility and dynamic balance (29.27%). AIMS2-SF: improved perceived physical function (23.16%), symptoms (11.20%), affect (36.36%), and social interaction (12.40%). NGSE: increase from (17 to 20), change (17.65%). PSEQ: increase from (21 to 30), change (42.86%). Difference between baseline and a.m. pain: decrease in pain by 0.16 point. Difference of retrospective pretest and posttest: pain decreased at posttest 0.50 point.

Mrs. Jeffers. Senior Fitness Manual: improved lower body strength (50.00%), lower body flexibility (28%), upper body flexibility (214.29%), and agility and dynamic balance

(11.63%). AIMS2-SF: improved perceived physical function (20.00%), symptoms (74.92%), affect (100%), and social interaction (25%). NGSE: decrease from (33 to 32), change (3.03%). PSEQ: Increase from (43 to 55), change (27.91%). Difference between baseline and a.m. pain: decrease in pain by 1.03 point. Difference of retrospective pretest and posttest: pain decreased at posttest 2.65 points.

Ms. Pace. Senior Fitness Manual: Decrease in lower body strength (8.33%), improved lower body flexibility (122%), upper body flexibility (50.00%), and agility and dynamic balance (4.35%). AIMS2-SF: No change in physical function (0.0%), improved symptoms (100%), no change in affect (0.0%), and social interaction decreased (15.37%). NGSE: No change in score of 40 (0.0%). PSEQ: no change in score of 60 (0.0%). Difference between baseline and a.m. pain: decrease in pain 0.12 point. Difference of retrospective pretest and posttest: pain decreased at posttest by 0.32 point.

Mrs. Sage. Senior Fitness Manual tests: improved lower body strength (25%), lower body flexibility (67%), upper body flexibility (7.14%), and agility and dynamic balance (11.63%). AIMS2-SF: decreased perceived physical function (28.76%), no change in symptoms (0.0%), improved affect (16.66%), no change in social interaction (0.0%). NGSE: decrease from (31 to 29), change (6.45%). PSEQ: no change in score of 50 (0.0%). Difference between baseline and a.m. pain: increase in pain by 1.25 points. Difference of retrospective pretest and posttest: pain decreased at posttest 1.54 points.

Juxtaposed primary data.

Pain data. Comparison of baseline to morning pain level means, four of six participants showed a decrease, and two participants showed an increase in perceived pain during participation with the intervention. Retrospective pretest and posttest mean pain levels, five of

six participants showed a decrease, and one participant showed an increase in perceived pain at posttest.

Senior Fitness Tests. The chair stand in 30 seconds test: results indicated that five of six participants showed improvement, and one participant showed a decrease, in lower body strength at posttest. Chair reach to touch toes test: results indicate five of six participants showed improvement, and one participant showed a decrease, in lower body flexibility at posttest. Scratch the back test: results indicate that five of six participants showed improvement, and one participant no change, in upper body flexibility at posttest. Eight foot get up go test: results indicate that five of six participants showed improvement, and one participant showed a decrease, in dynamic balance and agility at posttest.

AIMS2-SF data. Physical function: results indicate at posttest, four of six participants showed improvement, one participant showed a decline, and one participant's scores showed no change, in perceived well-being of physical function. Symptoms: results indicate at posttest, five of six participants showed improvement, and one participant's scores showed no change, in perceived well-being of symptoms. Affect: results indicate at posttest, four of six participants showed improvement, one participant showed a decline, and one participant showed no change, in well-being of perceived affect. Social interaction: results indicate at posttest, three of six participants showed improvement, two participants' scores had no change, and one participant's scores showed a decrease, in perceived well-being of social interaction.

New general self-efficacy scale scores. Results indicate at posttest, three of six participants showed a decline, one participant showed an increase, and two participant's scores showed no change in perceived general self-efficacy.

Pain self-efficacy questionnaire scores. Results indicate at posttest, three of six participants showed a decline, one participant showed an increase, and two participant's scores showed no change in perceived pain self-efficacy.

Summary

Findings from the ExPRT AB 2.0 graphical representations of participant retrospective pretest and posttest pain scores, combined with the visual analysis of pre and post crossover data of the mean, level, trend, and variability, indicated there was no significant difference in pain levels between the two treatments. This finding was substantiated through sensitivity analyses with a mixed-model linear regression, and a paired t-test. Although there was no difference between the two conditions on levels of perceived pain, improvement in participant pain, well-being, and physical function was indicated through engagement with the intervention itself.

Excel 2013 generated graphs and score means of primary pain data, indicated participant average decrease in pain level between baseline and a.m. means of 0.32 point during the study, and an average decrease in perceived pain was indicated between retrospective pretest and posttest means by 0.77 point. Neither of these scores meet the minimal important clinical difference in a change in pain of one point on the NPRS scale. Nonetheless, the scores indicate a small average decrease in pain among the participants.

Findings from the analysis of the AIMS2-SF participant retrospective and posttest score means indicated that the intervention had a positive effect on perceived well-being. In order of the highest to lowest average impact on participant scores: symptoms improved by (M = 1.94) points; followed by improvement on affect (M = 1.41) points; improved social relations (M = 0.42) point; and improved physical function (M = 0.21) point. Findings from the pretest and posttest data from the Senior Fitness Test Manual indicated that the intervention had an effect on

participant lower body strength with participants averaging three more stands on the 30 second chair stand test at posttest; an average improvement in lower body flexibility by 1.42 inches on the chair to touch toes test; an average improvement in upper body flexibility by 0.93 inch on the scratch the back test; and improvement in dynamic balance and agility, an average decrease in time to perform the eight foot up and go test by 0.87 second. All of these physical performance measures showed improvement, indicating that engagement with the intervention may have had a positive impact on participant functional movement. Findings from the means of the NGSE scores indicated an average decrease of general self-efficacy at posttest of 1.00 point, whereas the means of the PSEQ scores indicated an average improvement on pain self-efficacy at posttest of 7.50 points. Comparing the outcomes on participant general self-efficacy and pain self-efficacy, indicates that levels of self-efficacy for the six participants were contradictory.

In general, it appears that the preliminary findings of the study indicate that there may have been a positive effect of the intervention on participant perception of pain, measures of physical performance, health related measures of well-being, and pain self-efficacy. All of the measures had varying levels of impact depending on the test and the participant. Not all of the participant's individual outcomes improved, indicating some contradiction and ambiguity of the findings. This study assessed a very small sample over a short period of time, the outcomes of the study are a precursor for further inquiry over a longer period of time with more participants.

Chapter IV

Manuscript I

Addressing Osteoarthritis Pain Among Older Adult Women Through Aquatic Therapy: A New Look at Shallow Water Movement

To submit to the *Therapeutic Recreation Journal*

Abstract

This study evaluated a shallow-water functional movement intervention through the use of a stationary pole by older-adult women between the ages of 61 to 81 with knee and or hip osteoarthritis (OA), to determine if the intervention affected perceived pain compared with shallow-water movements without the stationary pole. The study used an experimental randomized and replicated single-case two-condition (AB), crossover design to collect data. Data were collected through repeated pain measures, pretest and posttest treatment measures, and retrospective pretest and posttest measures. Pain data from retrospective pretests and posttests, were entered into the Microsoft Excel® ExPRT 2.0 single-case AB program to generate graphs of pre and post-crossover condition data. Visual analysis of graphs and descriptive retrospective pretest and posttest pain data, showed no significant difference between the two conditions. For the recreational therapist, and the individual, results indicate use of a pole may not be more effective on perception of pain than the movement program itself; this may translate to cost effective therapeutic interventions that address clinical outcomes.

Keywords: pain, osteoarthritis, aquatics, older-adults, functional-movement, self-efficacy.

October, 2017

By

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Addressing Osteoarthritis Pain Among Older Adult Women Through Aquatic Therapy: A New Look at Shallow Water Movement

Introduction

The older adult population worldwide is growing rapidly, in North America, older adults over the age of 65 will comprise approximately 20% of the total population of this area by the year 2030 (A. Fisken, Waters, Hing, Steele, & Keogh, 2014). Accompanying this increase of the older adult population, are the normal changes of diminished physical and cognitive abilities that happen to everyone as we age. The occurrence of these detrimental changes related to aging, such as osteoarthritis (OA), will increase and remain a public health concern (Fisken et al., 2014). Globally, OA is projected to be the most widespread among older adults; the knee and hip being the joints that are typically affected (Uthman, 2013). The most prevalent symptoms associated with OA are pain, followed by weakening of the muscles, diminished motor function, and reduced well-being (Lu et al., 2015). Facilitating non-pharmaceutical interventions, such as shallow-water exercise grounded in self-efficacy to ameliorate pain, is one way recreational therapists can address this health care problem.

Within recreational therapy, self-efficacy has emerged as a consistent mediator on the effect of outcomes related to health; such as, life quality, managing symptoms associated with disability, and psychological well-being (Mailey & McAuley, 2014; Piatt, Compton, Sara Wells, & Bennett, 2012; Rose, Piatt, Zahl, & Kim, 2008). Additionally, there has been observational research substantiating that self-efficacy may aid in the explanation of the association between being physically active and the perceived severity of symptoms of adverse physical conditions. For instance, one's judgment of their self-assuredness to participate in an exercise may be influenced by the level of pain that the individual is perceiving (Sperber et al., 2014). According

to Bandura (Bandura, 1997, 2004), self-efficacy relates to an individuals' belief in their ability to successfully execute the tasks necessary to overcome challenging situations to achieve intended goals (as cited in Pomeroy & Clark, 2015). Furthermore, individuals aspire to be proactive toward the setting of goals. The capacity to foresee obstacles to achieving a goal, allows the individual to exert anticipatory and adaptive control of their response to perceived obstacles, instead of reacting to the outcome of one's actions (Bandura, 2012). This strategy of adaptation to attain one's goals corresponds with the principles of the selection, optimization, and compensation model.

The selection, optimization, and compensation (SOC) model, refers to an individual's adaptive strategy of action that through their entire life span, will support their well-being and health (Müller et al., 2015). During the aging process, adults are faced with more and more restrictions within their social, physical, and mental capabilities. SOC offers a foundational conceptual structure that describes the psychological process of the older adults' adaptation to aging that attempts to preserve and maintain a high level of life satisfaction and well-being (Hawkins, 2009). An individual with symptoms related to OA such as pain, will intuitively use the tenets of the SOC model to choose activities that will lessen, rather than exacerbate, their pain (M. A. Gignac, Cott, & Badley, 2000).

In older adults, pain is often characterized as being of severe to moderate intensity and of a constant nature that can last for many years. Chronic pain lasts longer than six months and can hinder an older adult's propensity to engage in social, physical, and daily living activities (Tse, Leung, & Ho, 2012), and is recognized as a potential barrier to exercise (A. Fisken et al., 2015). If long term chronic pain goes unmitigated, it can lead to feelings of anxiety, loss of sleep, lessened mobility, strained social relationships, and depression (Kinghorn, Robinson, & Smith,

2015). Pain along with physical impairment are central factors of hardship for individuals with OA that leads to a reduction of well-being (Jebakani et al., 2015). In consideration of the profound consequences of the relationship of pain on older adult cognitive and physical well-being, as well as, the exhaustive drain on personal and societal health care costs, there is an important need for health care professionals, as well as older adults, to cost effectively manage pain through nonpharmacological interventions (Park et al., 2013).

Older adults use medication, such as opioids, to treat and manage pain more than any other age group (Shrestha, Schofield, & Devkota, 2013). Addiction to opioids and prescribed pain medication has become a serious problem affecting the economic, health, and social welfare of every society worldwide (Volkow, 2014). Moreover, there is an increasing amount of research that substantiates the effectiveness, and use of, nonpharmacological treatments as a viable choice for older adults to manage their pain without prescription pain medication, that include side-effects and adverse drug interactions related to polypharmacy (Park et al., 2013). Considering all of the drawbacks of the pharmacological approach to pain management, recreational therapeutic aquatic centered exercise may offer older adults with OA, a safe and cost efficient way to reduce pain (Fisken et al., 2014).

According to authors Austin and Crawford (2001), the profession of therapeutic recreation is first of all, an avenue to self-restoration to recapture one's sense of equilibrium and stability in the wake of a threat to one's health; thus protecting health. Secondly, it is a way to self-development by way of leisure to actualize the self; by promoting health. The primary objective of therapeutic recreation is: health restoration through education, to help the individual make use of leisure to optimize their full potential, for the highest possible enjoyment of life quality (as cited in Anderson, 2012). Authors Anderson and Heyne (2012), add to the above

definition of therapeutic recreation with the following statement. The practice of therapeutic recreation is to carefully facilitate the experience of leisure in a purposeful, high quality manner, to develop environmental and personal strengths, that lead to a greater sense of well-being to individuals; who because of disability, illness, or additional life conditions of circumstance, require individualized help to achieve their dreams and goals (as cited in Anderson, 2012). In the past, reports from literature on aquatics generally agree on the viability of water as a potential medium for the enhancement of life quality for individuals with a disability. Founded upon the findings of these reports, therapeutic aquatic exercise is a treatment that the therapeutic recreation professional can utilize for the promotion of physical and psychological improvement, at the same time, facilitate individual independence through swimming and therapeutic aquatic exercise (Broach & Dattilo, 1996).

Exercise in water, also referred to as aquatic exercise, has a lengthy history within health promotion; as well, its popularity is experiencing a wider and growing older adult audience (Lu et al., 2015; Thompson, 2015). First of all, one of the unique characteristics of aquatic exercise is less stress on the lower joints of the body. The property of buoyancy on the human body reduces gravity's effect on weight bearing joints that can be perceived as feeling better about oneself, reducing pain and fatigue, and providing greater enjoyment; translating to improved well-being (Lu et al., 2015). Minimal research exists that investigates the effect of water based exercise on OA of the knee and or hip (E. M. Bartels et al., 2009; Alison Fisken et al., 2014). Additionally, research on water based exercise has indicated contradictory findings on some of the main variables of interest, including pain (Ansari, Elmieh, & Hojjati, 2014). For older adults with OA of the knee and or hip, engaging with a movement routine in shallow water can be

enhanced by incorporating movements that are designed to facilitate functional movement in our daily life activities.

Functional or neuromotor movement is the capability to enact the production and maintenance of a balance between being physically mobile and maintaining one's stability, while enacting a basic pattern of movement efficiently and accurately. Thus having flexibility and maintaining one's balance, physical coordination, and strength, are necessary constituents of the production of functional movement (Okada, Huxel, & Nesser, 2011). In the American Council on Exercise (ACE) textbook, it identified the five fundamental movements that comprise the functional movements that humans use in their daily life activities (as cited in Kennedy, 2014). The five fundamental functional movements are: (a) pulling and pushing; (b) lowering and raising; (c) locomotion; (d) rotation; and (e) combinations of these abilities to achieve full range of motion movement (Sanders et al., 2016). In practical consideration of the importance of humans to accomplish and maintain normal daily life activities, the investigator developed a set of functional movements for subjects to use during the intervention of the study.

The incidence of older adults with OA is rapidly increasing and makes up a significant portion of the population. One of the major side effects of OA is chronic pain, which can have a devastating effect on overall health and well-being. In light of the detrimental side effects associated with taking pain medications, including the financial burden to the individual and to society, a nonpharmacological intervention, such as shallow-water functional movement, may be a cost effective way to manage pain.

Methods

Subjects

Subjects were sought through flyers and on-line volunteer email lists. Flyers were posted at older-adult centers, and rheumatology/arthritis treatment offices, following recruitment protocols from prior research (Suomi & Koceja, 2000). Subjects were offered gift cards; ten dollars for attending each session and 25 dollars for completing the study. Inclusion criteria: people 60 to 85 years old, previously diagnosed with hip and or knee OA with physical and cognitive ability to engage in the aquatic intervention and complete all questionnaires. Exclusion criteria: recent injection of steroids; current participation with an aquatic exercise program; reports of untreated cardiovascular disease, stroke, or untreated high blood pressure (BP); latter stages of dementia or Parkinson's disease; or not getting approval of their physician.

A small sample of older adult women (n = 6) were enrolled in the study, who had been diagnosed with knee and or hip OA. The six women were between the ages of 61 and 81 (M = 67.70), (BMI):(M = 26.40). Pseudonyms were given to each of the subjects for anonymity.

Mrs. Madison. Is a married sixty-one year old Caucasian woman who has been living with OA of the knee and hip for one and a half years. During the study, she did not take prescribed medication for pain, she attended the intervention at YMCA I.

Mrs. Ulman. Is a married sixty-one year old Caucasian woman, who has been living with OA of the knee and hip for 23 years. While in the study, she was not taking prescribed medication for pain and she attended the intervention at YMCA I.

Mrs. Campbell. Is a married eighty-one year old Caucasian woman, who has been living with OA of the hips for seven and one-half years. During the study, she did not take prescribed medication for her pain, she attended the intervention at YMCA I.

Mrs. Jennings. Is a married sixty-three year old Caucasian woman, who has been living with OA of the knees for six and one-half years. She did not take prescribed medication for pain during the study and she had one knee replacement surgery, she attended the intervention at YMCA II.

Ms. Park. Is a divorced seventy year old Caucasian woman, who has been living with OA of the knee for approximately five years. While in the study, she did not take prescribed medication for pain, she attended the intervention at YMCA II.

Mrs. Silva. Is a married seventy year old Caucasian woman, who has been living with OA of the knee for approximately ten years. During the study, she did not take prescribed medication for pain, and she attended the intervention at YMCA II.

Setting

There were two local YMCA's in the community where the study was implemented. The intent of the study was to have all six subjects engage with the intervention at the YMCA-I facility. Because the decks of the pool at the YMCA-I facility were being cleaned during the time of the intervention on Tuesdays, closing the pool; it was decided to have three subjects engage with the intervention at the YMCA II facility on Tuesdays, Thursdays, and Saturdays.

Procedures

There were two intervention conditions (the independent variables), the primary condition (A) individual instruction in prescribed aquatic functional movement positions facilitated without the use of a stationary pole. The secondary condition (B) individual instruction in the same prescribed aquatic functional movement positions with the use of a stationary pole. Both conditions were introduced in a systematically randomized manner, to six subjects in shallow-water (depth of 3.50 feet, approximately chest deep) at light intensity levels,

for five weeks, three sessions per week. The intervention consisted of a five minute warm-up, 30 minute program, and a five minute cool-down, per session. Prior to beginning the study, subjects were randomly assigned into three pairs. By pairing the subjects together, each person within their pair during the intervention, would at a randomly selected crossover point, simultaneously crossover to the other condition that they began the intervention with. Thus, strengthening the ability to determine the effect of the two conditions on subject perceived pain.

Intervention. The study was comprised of three phases.

Phase I (A') baseline pretesting: After submitting the signed informed consent, subjects met in a conference room at the YMCA I facility for measures of physical function, (BMI), blood pressure (BP), cognitive ability, and demographic information. The following day, each subject was telephoned at approximately 11:50 a.m. to report level of pain using the numerical pain rating scale (NPRS). Subjects received one phone call each day at the same time, for the next five days to establish baseline pain levels.

Phase II (AB) intervention: subjects were introduced at random to the two conditions. All exercises were light intensity stretching and walking, water temperature 85 to 86 degrees ^{o}F, at a depth of three and one-half feet. Before coming to each afternoon session, each subject was called at approximately 11:50 a.m. and asked to respond to the NPRS, to report level of pain. After each session, each subject was shown the NPRS and asked to report level of pain before getting into the pool, and then report pain level after engaging with the intervention. These two questions constituted the retrospective pretest and posttest pain data.

Phase III Post-testing: subjects met in a program room at the YMCA I facility. Measures included: BP, BMI, and measures of physical function. Subjects filled out three posttest instruments on perceived well-being, general self-efficacy, and pain self-efficacy. Later in the

same session, subjects filled out the same measures but asked to answer the questions as to how they perceived themselves prior to engaging with the intervention, as retrospective pretests.

Repeated pain measure instrument. The NPRS was chosen for its ease of use, reliability, and validity. Reliability (r = 0.95). Validity, range (0.86 – 0.95): (Hawker, 2011). For the NPRS, the clinically important minimal difference in a change of intensity of chronic pain, is a change of one point or, 15.0% (Salaffi, Stancati, Silvestri, Ciapetti, & Grassi, 2004).

Data Analysis

Visual analysis of data. Single-case research customarily relies on the visual assessment of the graphed data, to determine if there exists evidence of a relationship between the dependent and independent variables, as well as, determine the magnitude or strength of the relationship, if it exists (T. R. Kratochwill et al., 2010). Following established protocol, the study used visual assessment of the data to analyze how consistent the patterns of the data points were in relation to mean, variability, trend, and level of the effect of the intervention on the dependent variables (Kratochwill et al., 2013).

Sensitivity Analyses. As a sensitivity analysis, a mixed model procedure for repeated measures using the Statistical Analysis System (SAS®) software version 9.4 (French, Galvin, Abbott, & Fransen, 2015). The procedure modeled the pain scores as the dependent variable and retrospective pretest and posttest times as the indicators of treatment and main exposure variables, adjusting for age, BMI, education, marital status, surgery to the lower limbs, and previous involvement in an aquatic program. To determine change in means from retrospective pretest to posttest values, a paired *t*-test was conducted.

Inter-assessor reliability. Visual analysis was conducted independently by an assistant and the investigator on graphs representing pain data generated by the Excel ExPRT 2.0 AB

program. Comparison of the visual analyses was performed using the R package computer statistical software (Revelle, 2017). Results of the R inter-assessor agreement analysis: Kappa coefficient of 0.67 with a [95% CI of (.32 to 1)].

Outcomes

Visual Analysis and Comparison of Means

The following figures, were generated with the ExPRT AB 2.0 program. The (y) axis range is: -10 to 0 to 10, a negative number indicates less pain, and a positive number indicates more pain.

Figure 1 about here

Mrs. Madison.

Level: A condition (M = 0.40), B condition (M = 0.50) levels of perceived pain.

Trend: line that fits best shows a rise from condition A to condition B, going up by 0.10 point.

Variability: A condition (*SD* = 0.547), B condition (*SD* = 0.527).

The difference in her pain levels went up from condition A to B by 0.10 point, indicating level of pain was higher during participation with the pole condition.

Mrs. Campbell.

Level: B condition (M = -1.40), A condition (M = -0.50) levels of perceived pain.

Trend: line that best fits shows rise from condition B to condition A of 0.90 point.

Variability: B condition (*SD* = 2.302), A condition (*SD* = 1.423).

The difference in her pain levels went up from condition B to A (0.90) point, indicating level of pain was lower during the pole condition.

Figure 2 about here

Mrs. Ulman.

Level: A condition (M = 0.07), B condition (M = -0.13) levels of perceived pain.

Trend: line of best fit, shows it going slightly down from condition A to condition B by (-0.20) point.

Variability: A condition (*SD* = 0.673), B condition (*SD* = 0.354).

The difference between her pain levels went down from condition A to B (-0.20) point, indicating level of pain was lower during participation with the pole condition.

Ms. Park.

Level: B condition (M = -0.36), A condition (M = -0.38) levels of perceived pain.

Trend: line of best fit shows a flat line from condition B to condition A, going down (-0.02) point.

Variability: B condition (*SD* = 0.244), A condition (*SD* = 0.354).

The difference between her pain levels went down from condition B to A (-0.02) point, indicating that perceived pain was slightly higher during participation with the pole condition.

Figure 3 about here

Mrs. Jennings.

Level: A condition (M = -2.31), B condition (M = -3.04) levels of perceived pain.

Trend: line that best fits show pain levels going down from condition A to condition B (-0.73) point.

Variability: A condition (*SD* = 0.799), B condition (*SD* = 0.742).

The difference between her pain levels went down from condition A to B (-0.73) point, indicating that pain level went down during participation with the pole condition.

Mrs. Silva.

Level: B condition (M = -1.63), A condition (M = -1.43) levels of perceived pain.

Trend: line of best fit shows a flat line going slightly up from condition B to condition A (0.20) point.

Variability: B condition (*SD* = 0.517), A condition (*SD* = 0.787).

The difference between her pain levels went up from condition B to A by (0.20) point, indicating that level of pain was lower when participating with the pole condition.

Sensitivity Analyses. Among the participants, there was no significant difference in pain scores comparing posttests to retrospective pretests; holding age, BMI, education, surgery of the lower limbs, previous participation with an aquatic program constant ($\beta = -0.52$, $p = 0.344$). A paired *t*-test was performed and found no significant difference in the means between the two conditions; $t(44) = 1.03$, $p = 0.310$.

Discussion

The objective of this study was to assess perceived level of pain in older adult women with OA of the knee and or hip, on the effect of participation with a shallow-water exercise without the use of a stationary pole, compared to participation with the same exercise with the use of a stationary pole. Through visual analysis of the data and interpretation of descriptive data, insights into the change in level, mean, variability, and trend from retrospective pretest and posttest pain measures were gleaned.

During participation with the pole condition, two subjects had a small increase in perceived pain and four subjects perceived a small decrease in level of pain. Three of the four subjects showed a positive change in level of intensity of pain that was less than the minimal clinical difference, and one subjects' positive change in pain level exceeded the minimum clinical change. Furthermore, the data showed that between pre-crossover means and post-

crossover means, there was no significant difference between the two intervention conditions. This result was substantiated with a follow up sensitivity analyses. Although four out of the six subjects' positive change in a pain levels were not very large, a small positive effect of an aquatic exercise such as a shallow-water exercise on perceived pain, is in alignment with previous studies (E. M. Bartels, Juhl, C.B., Christensen, R., Hagen, K. B., Danneskiold-Samsoe, B., Dagfinrud, H., Lund, H. , 2016; Johnson, Keyan, & Rosario, 2016; Waller, 2014).

Study Limitations

The study was conducted over a short period of time with a small sample size of six participants. Subject exposure to the test measure may have affected follow-up exposure to the same test that could get mistaken for the effect of the intervention. The effect of one internal validity threat could have influenced the level of response to another internal validity threat (T. Kratochwill et al., 2010). There were also times when other people were in and around the same area as the instruction of the intervention, this may have caused discomfort or distraction for the subjects and may have influenced their responses to test measures. The subjects may have engaged in other activities that could have affected the outcomes of the study. Subjects could have tried to placate the investigator by answering questions as how they interpreted the investigator may have wanted them to answer the questions. The intervention was held at two different facilities, this may have affected the consistency of implementation of the exercise protocol. Except for blind randomization of the subjects, there was no other blinding of the procedures of the study.

Further Research Recommendations

Further research could investigate how SOC and self-efficacy may play a role in how individuals with OA of the knee and or hip adapt to manage their pain to continue with an exercise program. Future studies with a larger, more heterogeneous sample, would increase the

power and strength of the outcomes. As well, a study where the intervention is conducted over a longer period of time with more subjects, may have different outcomes. With a longer intervention period, a post study follow-up would be appropriate to determine if the intervention had a lasting effect. Conduction of a similar study with the instruction given to more than one individual at a time, may be a way to determine if socialization has an effect on self-efficacy and the SOC model.

Implications for Practice

The findings from this investigation indicate that from participation with an aquatic exercise with or without a stationary pole by older adult women with OA of the knee and or hip, there is no significant difference in subject perceived pain between the two conditions. If the RT professional can make even a small positive difference in an individual's level of pain through a shallow-water intervention with or without equipment, this could be of benefit to older adult women with OA of the knee and or hip as a nonpharmacological way to manage pain. Furthermore, because there was no discernable differences between the two conditions, the individual may find a personal preference for one or the other condition. Thus, the recreational therapist and the individual can determine which mode best fits the interests and strengths of the individual.

Conclusion

Through visual analysis, comparison of the graphed subject-pair pain data, as well as the comparison of the pre-crossover and post-crossover means, it was evident that there was no convincing difference between the two conditions. This finding was corroborated through follow-up sensitivity analyses. However, four out of six subjects perceived some improvement in perceived pain during the intervention. For the recreational therapy professional, and the

individual who engages with an aquatic exercise program, the findings indicate that the use of an apparatus may not be any more effective on one's perception of pain than the functional movement program itself. This knowledge could ultimately result in a cost savings for the recreational therapist and the individual.

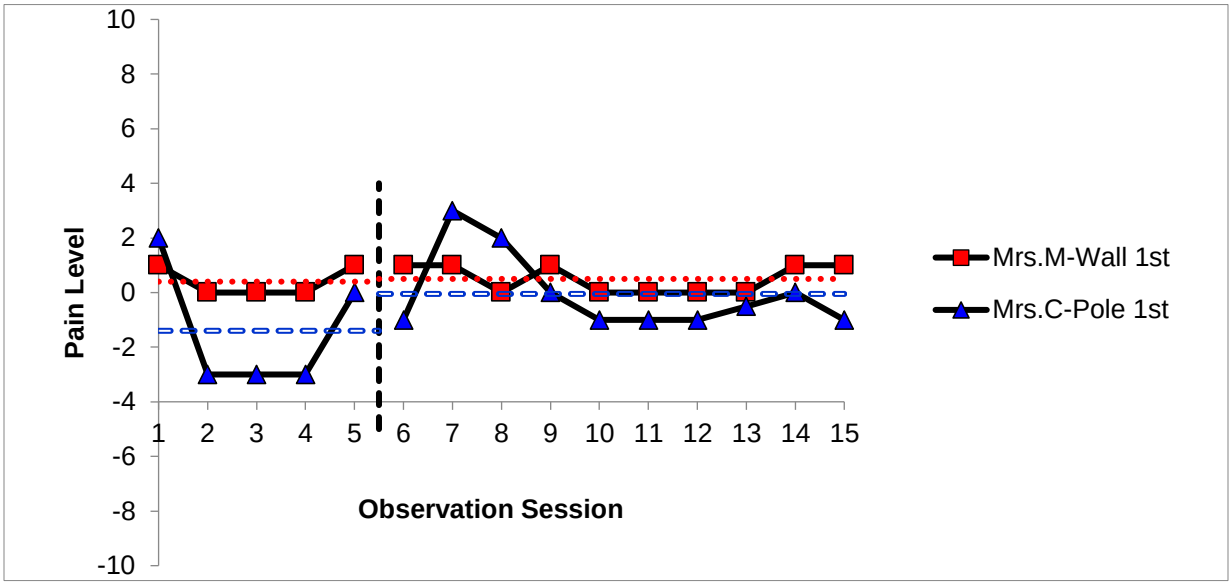

Figure 1. Subject-pair 1. Mrs. Madison - Mrs. Campbell. Randomized crossover at session 6. Visual analysis of subject-pair 1.

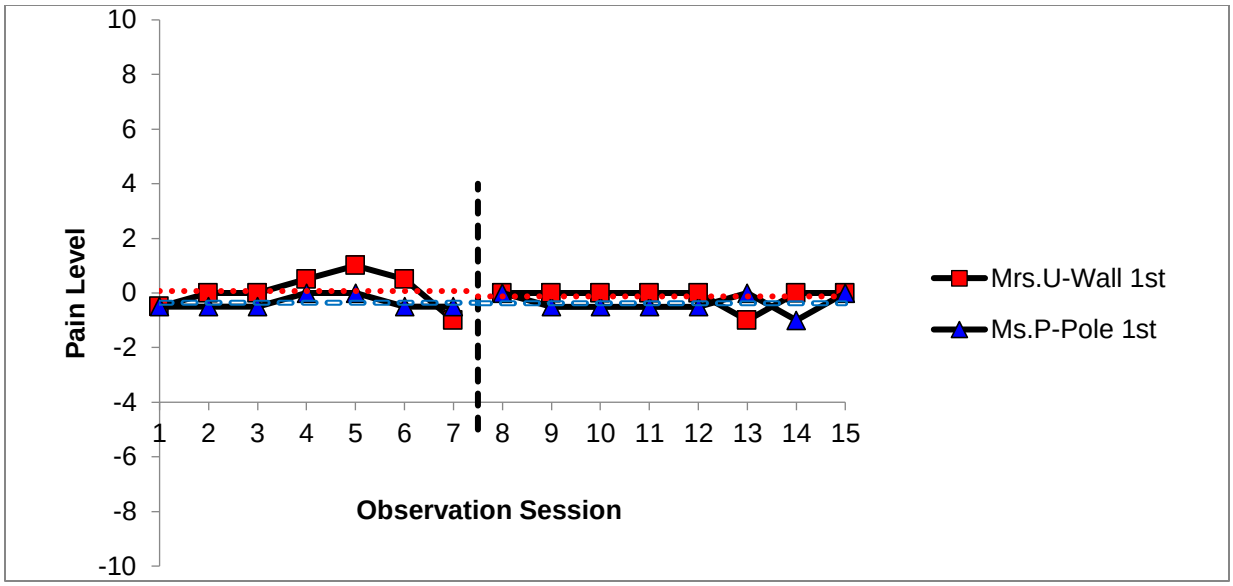

Figure 2. Subject-pair 2. Mrs. Ulman - Ms. Park. Randomized crossover at session 8.

Visual analysis of subject-pair 2.

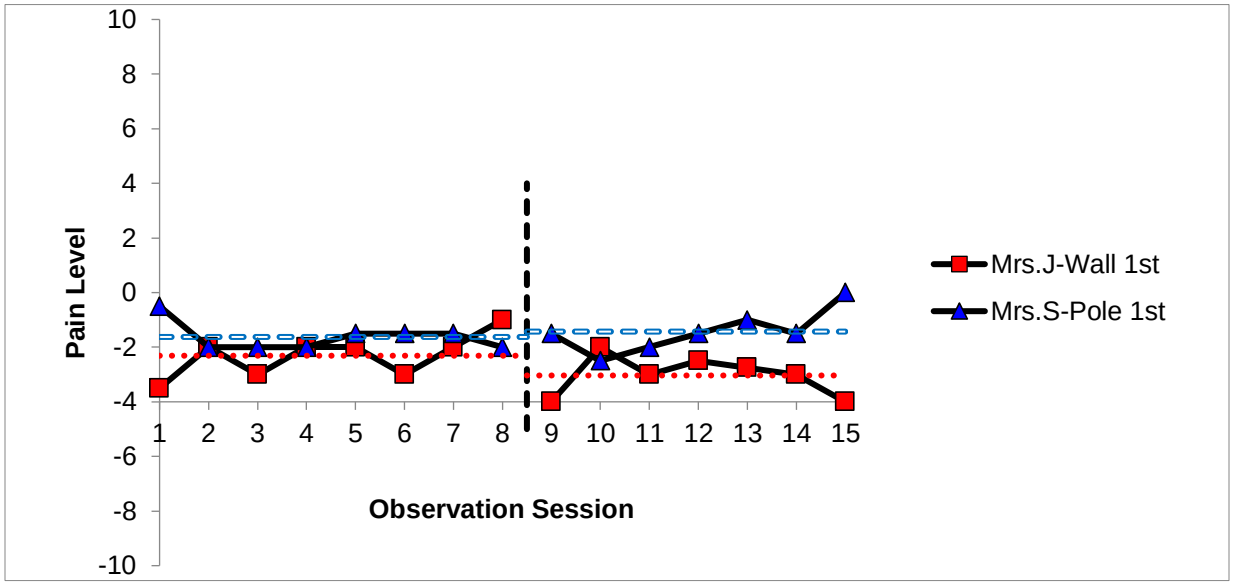

Figure 3. Subject-pair 3. Mrs. Jennings - Mrs. Silva. Randomized crossover at session 9.

Visual analysis of subject-pair 3.

CHAPTER V

Manuscript II

The Impact of Functional Movement in Shallow-Water on the Well-Being of Female Older Adults with Hip and or Knee Osteoarthritis

To submit to the *International Journal of Aquatic Research and Education*

Abstract

This research investigated if functional movement in shallow-water through the use of a stationary pole by older adult females ages 61 to 81 who were diagnosed with hip and or knee osteoarthritis (OA), had a direct effect on perceived well-being. The study employed a replicated and randomized, two-treatment crossover, single-case design. Data were gathered with repeated measures of pain ($\alpha \leq 0.05$), posttest and retrospective pretests, and pre and post treatment measures. Comparison of individual AIMS-SF scores and visual analysis of graphed differenced scores, indicated that overall, a positive difference in health related well-being was detected between retrospective pretests and posttests on perceived mobility, symptoms of stiffness or pain, feelings of nervousness, and social relations. However, individuals differed on the scale of well-being that they improved upon. The study preliminarily found a positive correlation between the shallow-water treatment and well-being that warrants further investigation.

Keywords: aquatic therapy, well-being, activities of daily living (ADLs), functional movement, OA, older-adults.

The Impact of Functional Movement in Shallow-Water on the Well-Being of Female Older Adults with Hip and or Knee Osteoarthritis

Introduction

Osteoarthritis (OA), is one of the most common musculoskeletal system diseases, impacting over 27 million individuals annually, often leading to functional decline in older adults that can directly impact the perception of well-being (Castrogiovanni & Musumeci, 2016). OA is a disorder of the joint caused by cartilage degeneration that creates stiffness and pain in the affected joints. Typically, the symptoms progress over time, especially within the knee and hip joints. By age 65, 70% of females and 60% of males will have symptoms related to OA, causing impairment, disability, and ongoing chronic pain. Amongst people with OA, exercise routines can improve physical function, help reduce pain, and enhance well-being (Van Liew et al., 2013). Poor health has been related to a diminished sense of well-being, in particular, with illnesses that are ongoing or chronic, such as OA. With regard to lifestyle, physical activity such as shallow-water exercise, may be of great importance to an association between health and well-being. For instance, physical activity such as shallow-water exercise, is recommended for older adults on a regular basis, because it helps maintain flexibility, muscle strength, a healthy cardiovascular system, and control of optimal weight; all having been correlated consistently with perceived well-being (Steptoe, Deaton, & Stone, 2015).

A fundamental indicator of aging well in one's later years, is related to the concept of subjective well-being. It has garnered the attention of policy decision makers, researchers from several disciplines, and the general public. The concept of subjective well-being is in reference to an individual's qualitative self-evaluation of certain aspects within their present life situation. Subjective well-being can be thought of as an overall statement relating to particular domains of

one's experiences in life; such as: personal development, being independent, socially involved, and being physically well. The significance of the effect of being physically active has been identified as a contributing factor to an individual's overall physical function and well-being. At the same time, in the older adult population, recent emergence of empirical evidence suggests that physical activity, like shallow-water exercise, diminishes the onset of dementia and depression, the reduction of risk of cognitive illness, and the improvement in levels of subjective well-being (Ku, Fox, Liao, Sun, & Chen, 2016). For individuals with symptoms related to OA of the hip or knee, the aquatic environment including shallow-water exercise, offers a practicable alternative to staying physically active compared with similar movement on land (E. M. Bartels et al., 2009; Waller, 2014).

Aquatic exercise, such as movements in shallow-water, provide an environment that support weight bearing joints that can allow an individual to achieve physical movement that could not otherwise be accomplished on land; thus exercise in the water is an excellent mode of physical activity, especially for older adults with OA (A. L. Fisken et al., 2015). For individuals with joint pain, water provides a safe environment in which to exercise. This is because the property of buoyancy on the human body in water, lessens the weight bearing impact on the lower part of the body that is experienced when one exercises on land (Mary E. Sanders, 2011). For older adults, being in the aquatic environment can diminish the risks of disabling conditions in relation to aging, at the same time, increase mobility. For example, one's sense of balance and ability to achieve daily life activities are impacted through their mobility; yet, some older adults can have persistent limiting ailments like OA, that hinder their ability to engage in land based exercise. Being immersed in water can reduce the risk and fear of falls, and furnish a comfortable, effective, and safe way to train; improving one's mobility and their health (Mary E.

Sanders, Nobuo, Rogers, Colado, & Borreani, 2013). As well, there has been a lack of research that has investigated the effectiveness of aquatic exercise on OA of the lower extremity (E. M. Bartels et al., 2009; Alison Fisken et al., 2014). The ability of shallow-water aquatic exercise to facilitate older adult daily life activities is enhanced through the incorporation of the concept of neuromotor training, commonly referred to as functional movement.

There are five fundamental movements that comprise the functional movements that humans use in daily life activities. These movements are: (a) squatting (lifting and bending movements); (b) lunging (individual leg movements); (c) pull movements; (d) push movements; and (e) movements of rotation (Kennedy, 2014). According to the American College for Sports Medicine (ACSM), exercise and being physically active have been associated with several indisputable cognitive and physical benefits to health. Also, an active lifestyle has been correlated with a lowered risk of dementia and mental decline, enhancement of one's life quality, mental function, and well-being. The ACSM recommends a regular regimen of exercise that encompasses flexibility for better range of movement; group movement to stimulate the cardiorespiratory system; functional movement training that involves: agility, coordination, and balance; and resistance training (Garber et al., 2011). These recommendations are intended to prevent or delay disability in later life. A program that will incorporate functional movements that are similar to the performance of daily life activities, such as shallow-water exercise, may well suit these recommendations (Liu, C., Shiroy, D., Jones, L., & Clark, D. 2014).

The objective of this study was to determine if engagement with a functional movement treatment in shallow-water (depth of 3.50 feet, approximately chest deep), had an effect on the perception of well-being amongst female older adults ages 61 to 81 diagnosed with symptoms of hip and or knee OA. Thus, does participation by older adult females with hip and or knee OA in

shallow-water movement with or without use of a stationary pole based on self-efficacy, and the selection, optimization, compensation model, produce a significant improvement on subject perception of well-being? The null hypothesis states that there is no difference in participant subjective well-being after engagement with the aquatic treatment.

Methods

Participants

Participants were identified through flyers and volunteer email lists. Flyers were posted at community facilities for older adults, and arthritis/rheumatology medical offices (Suomi & Koceja, 2000). As incentive, flyers indicated weekly gifts cards would be given for attendance and completion of the study. Inclusion: 60 - 85 years of age, diagnosed with knee and or hip OA, cognitive and physical ability to participate with the aquatic study. Exclusion: physician disapproval to participate; being in an aquatic therapy class; current use of steroids; reports of stroke; abnormal blood pressure, and cardiovascular problems that went untreated, or later stages of Parkinson's or dementia. Potential participants were anonymously prescreened over the phone for adverse health conditions that could preclude them from the study. After submitting the signed informed consent document, each potential participant had to walk up a flight of stairs and walk 300 feet unassisted, plus hand fill out a cognitive questionnaire prior to enrollment into the study.

Six older adult females were enrolled to participate with the intervention, who had been identified with hip and or knee OA. Average BMI for the six females (M = 26.40), range in age from 61 to 81 (M = 67.70). All participants resided within the local community, had some college, or went on to finish their undergraduate or graduate degrees, all identified as Caucasian. Pseudonyms in place of actual names were used for all participants.

Mrs. Messina. Is 61 years old, married, and had been diagnosed with OA of the hip and knee one and half years ago. She did not take prescribed medication for pain during the study. She reported that because of pain in her left knee and left hip, her level of movement can be restricted. Despite her OA, she was physically active and exercised regularly. She gets emotional/social support most of the time. Mrs. Messina attended Mondays, Wednesdays, and Fridays; she did not miss any treatment meetings.

Mrs. Ulrich. Is 61 years old, married, and had been diagnosed with OA of the hip and knee 23 years ago. She did not take prescribed medication for pain while in the study. She indicated walking on hard surfaces too quickly is painful and can get worse due to inflammation. She reported that she rarely gets the emotional/social support that she needs. Mrs. Ulrich attended Mondays, Wednesdays, and Fridays; she did not miss any treatment meetings.

Mrs. Calloway. Is eighty-one years old, married, and has had OA of the hips for seven and one-half years. She did not take prescribed medication for pain throughout her involvement with the study. She stays physically active doing chores, and walking around the house. She sometimes gets the emotional/social support that she needs. Mrs. Calloway attended on Mondays, Wednesdays, and Fridays; and missed two out of 15 treatment meetings.

Mrs. Jeffers. Is sixty-three years old and married, who has OA of the knees for six and one-half years. She did not take medication for pain during the intervention and reported one of her knees had been replaced. She was regularly physically active at least five days per week. She indicated that she always gets the social/emotional support that she needs. Mrs. Jeffers attended on Tuesdays, Thursdays, and Saturdays; and missed one out of 15 treatment meetings.

Ms. Pace. Is seventy years old and divorced, who has had knee OA for five years. She did not take prescribed medication for pain while engaged with the study. She was physically

active every day of the week doing yard work, exercising, and walking her dog. She gets the social/emotional support that she needs most of the time. Ms. Pace attended on Tuesdays, Thursdays, and Saturdays; she did not miss any treatment meetings.

Mrs. Sage. Is seventy years old and married, who has had knee OA for ten years. She did not take prescribed medication for pain during the study. She had been physically active on a regular basis for the last six months. She sometimes gets the social/emotional support that she needs. Mrs. Sage attended on Tuesdays, Thursdays, and Saturdays; she did not miss any treatment meetings.

Setting

In the Midwestern university town where the study was performed, were two YMCAs with therapeutic swimming pools, i.e. YMCA-I and YMCA-II. Closing of the pool at YMCA-I to clean the pool decks occurred every Tuesday afternoon at the same time as the instruction of the treatment. Consequently three participants engaged with the study at YMCA II on Tuesday, Thursday, and Saturday afternoons. The other three participants attended the treatment meetings on Monday, Wednesday, and Friday afternoons at YMCA-I.

Procedures

This study employed a replicated randomized two-condition, single-case crossover method to gather data from six older adult females who had previously been diagnosed with moderate to mild, hip and or knee OA. Repeated measures, pre and post treatment testing, and retrospective pretest and post-testing, were utilized to gather data related to pain, physical function, self-efficacy, and well-being.

Intervention. The intervention was performed in three segments.

Segment I. Baseline **(**A[1]): Participants provided their signed informed consent, documents about current regular physical activity, and past and current health status (PAR-Q+). Pretesting consisted of measures of blood pressure (BP), body mass index (BMI), demographics, physical ability, and cognitive function. Testing occurred at YMCA I, in a conference room. The next day, each participant was phone called at roughly11:50 a.m., to report their perceived intensity level of pain. Participants then got one phone call for the next five days at roughly11:50 a. m., for a total of six pain measurements to establish baseline levels of pain.

Segment II. Intervention (AB): Two independent variable conditions were randomly introduced to the participants, the (A) condition: movements in water without the use of a stationary pole and, the (B) condition: the same movements with the use of a stationary pole. Participants engaged in the instruction of the treatment conditions individually and began one-on-one engagement with a certified aquatics arthritis leader with the aid of an instructional video of the movements. Participants engaged with the treatment for five weeks in shallow-water, (depth of three feet six inches), three days a week for 15 meetings. Water temperatures were kept between 85 and 86 degrees ^{o}F at both facilities. Prior to coming to each afternoon meeting, each participant was called at roughly 11:50 a.m. to report the intensity level of their pain. After each treatment meeting when each participant exited the pool, the participant was asked to report their level of pain before engaging with the treatment, then asked how they perceived their level of pain after the treatment, as retrospective pretests and posttests. All of the movements consisted of slow walking and stretching in the water, at light intensity.

Segment III. Post-testing: In an alternate program room at YMCA I, participants had BP, and BMI measured, tested for basic mobility and dynamic balance, upper and lower flexibility,

and endurance of the lower body. The participants were first asked to fill out the Arthritis Impact Measurement Scales-Short Form (AIMS2-SF), the New General Self-Efficacy scale (NGSE), and the Pain Self-Efficacy Questionnaire (PSEQ) for post-testing, then later in the meeting, they were again asked to fill out the same test instruments and asked to answer the questions retrospectively prior to their involvement in the study.

Outcome measure instrument. The AIMS2-SF, was employed to measure subjective well-being. This is a shorter version of the Arthritis Impact Scales 2 (AIMS2). The AIMS2 was designed specifically to assess the psychological, physical, and social well-being of individuals with arthritis. Reliability: Chronbach's alpha range (0.75 – 0.87). Validity: a criterion validity that is similar to other measures on the status of disability and health. For the areas of physical function and symptoms, the AIMS2-SF exhibited more responsiveness to a change than the Modified Health Assessment Questionnaire (HAQ) and the Visual Analog Scale (VAS):(A. M. Gignac, Cao, Xingshan., McAlpine, Jessica., Badley, Elizabeth M., 2011).

Outcomes

Individual Participant AIMS2-SF Data

The AIMS2-SF is composed of five scales, one scale "Role" was not measured because it relates to being employed, all of the participants were retired. The range of scoring for all five scales is from zero to 10, with the lower the score, the better the perceived health related well-being. The four scales were: physical function: related to mobility and doing things; symptoms: related to perception of pain or stiffness; affect: related to perception of feeling nervous or tense; and social relations: related to perception of interaction with others. The formula used to get the absolute difference in test scores: (posttest – retrospective pretest = Δ score). A negative number

indicates a positive increase in perception of well-being for each scale. To get the percentage: (Δ score/retrospective pretest score = % of change).

The following tables represent AIMS2-SF participant subjective well-being data.

Mrs. Messina.

Table 1

AIMS2-SF scores: Mrs. Messina

Parameter	Retrospective Pretest Scores	Posttest Scores	Absolute Difference	Percent Change
Physical Function	1.67	1.46	-0.21	12.57%
Symptoms	3.33	2.50	-0.83	24.92%
Affect	2.50	3.00	0.50	20.00%
Social Relations	6.25	4.37	-1.88	30.08%

Mrs. Messina's scores show a positive change in physical function: 1.46 - 1.67 = -0.21, (12.57%) change, symptoms: 2.50 – 3.33 = -0.83, (24.92%) change, and social relations: 4.37 - 6.25 = -1.88, (30.08%) change. There was a negative change in affect: 3.00 - 2.50 = 0.50, (20.00%) change.

Mrs. Ulrich.

Table 2

AIMS2-SF scores: Mrs. Ulrich

Parameter	Retrospective Pretest Scores	Posttest Scores	Absolute Difference	Percent Change
Physical Function	2.09	1.46	-0.63	30.14%
Symptoms	4.17	0.00	-4.17	100%
Affect	4.50	0.00	-4.50	100%
Social Relations	8.13	8.13	0.00	N/C

Note: N/C stands for no change.

Mrs. Ulrich's scores indicate a positive change in perceived physical function: 1.46 - 2.09 = -0.63, (30.14%) change, symptoms: 0.00 - 4.17 = -4.17, (100.00%) change, and affect: 0.00 - 4.50 = -4.50, (100.00%) change. No change in score of 8.13 for social relations.

Mrs. Calloway.

Table 3.

AIMS2-SF scores: Mrs. Calloway

Parameter	Retrospective Pretest Scores	Posttest Scores	Absolute Difference	Percent Change
Physical Function	2.72	2.09	-0.63	23.16%
Symptoms	7.50	6.66	-0.84	11.20%
Affect	5.50	3.50	-2.00	36.36%
Social Relations	5.00	4.38	-0.62	12.40%

Mrs. Calloway's scores indicate improvement in perceived physical function: 2.09 - 2.72 = -0.63, (23.16%) change; symptoms: 6.66 - 7.50 = -0.84, (11.20%) change; affect: 3.50 - 5.50 = -2.00, (36.36%) change; and social relations: 4.38 - 5.00 = -0.62, (12.40%) change.

Mrs. Jeffers.

Table 4

AIMS2-SF scores: Mrs. Jeffers

Test Parameter	Retrospective Pretest Scores	Posttest Scores	Absolute Difference	Percent Change
Physical Function	1.05	0.84	-0.21	20.00%
Symptoms	6.66	1.67	-4.99	74.92%
Affect	1.50	0.00	-1.50	100.00%
Social Relations	5.00	3.75	-1.25	25.00%

Mrs. Jeffers' scores show improvement in physical function: 0.84 – 1.05 = -0.21, (20.00%) change; symptoms: 1.67 – 6.66 = -4.99, (74.92%) change; affect: 0.00 - 1.50 = -1.50, (100.00%) change, and social relations: 3.75 - 5.00 = -1.25, (25.00%) change.

Ms. Pace.

Table 5

AIMS2-SF scores: Ms. Pace

Parameter	Retrospective Pretest Scores	Posttest Scores	Absolute Difference	Percent Change
Physical Function	0.00	0.00	0.00	N/C
Symptoms	0.83	0.00	-0.83	100.00%
Affect	0.00	0.00	0.00	N/C
Social Relations	8.13	9.38	1.25	15.37%

Note: N/C stands for no change.

Ms. Pace's scores indicate no change in perception of physical function or affect; improvement of symptoms: 0.00 - 0.83 = -0.83, (100.00%) change, and a diminishment in social relations: 9.38 - 8.13 = 1.25, (15.37%) change.

Mrs. Sage.

Table 6

AIMS2-SF scores: Mrs. Sage

Parameter	Retrospective Pretest Scores	Posttest Scores	Absolute Difference	Percent Change
Physical Function	1.46	1.88	0.42	28.76%
Symptoms	5.00	5.00	0.00	N/C
Affect	6.00	5.00	-1.00	16.66%
Social Relations	7.50	7.50	0.00	N/C

Note: N/C stands for no change.

Mrs. Sage's scores indicate a decrease in perception of physical function: 1.88 - 1.46 = 0.42, (28.76%) change; no change in symptoms or social relations; and an improvement in affect: 5.00 - 6.00 = -1.00, (16.66%) change.

Combined Participant AIMS2-SF Data

Each of the following figures graphically illustrate the difference between retrospective pretest scores and posttest scores: (posttest – retrospective pretest = Δ score). A negative number indicates a positive increase in participant perception of health related well-being.

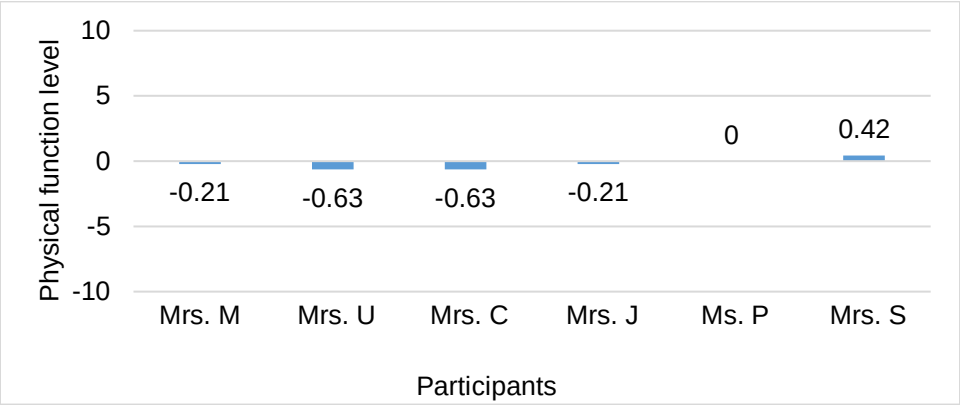

Figure 1. AIMS2-SF: Level of physical function.

Interpretation of the above scores: four participants perceived a small positive change, one participant perceived no change, and one participant a negative change in physical function. The mean of the six scores (M = -0.21), indicates the treatment had a small positive impact on perceived physical function.

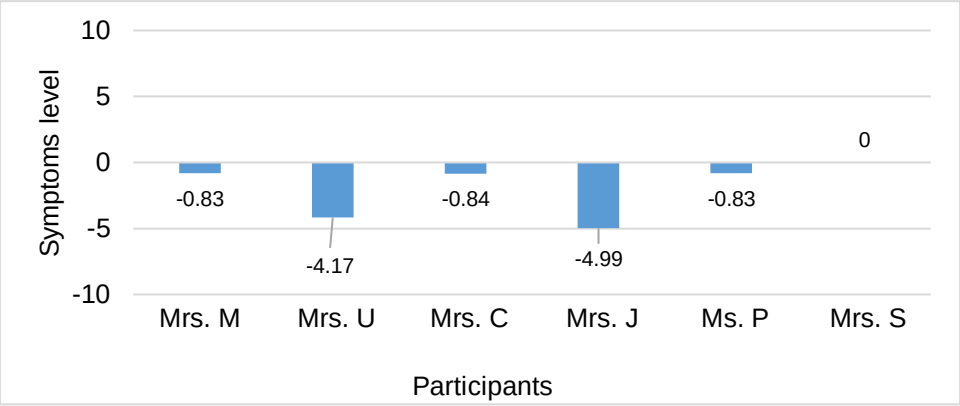

Figure 2. AIMS2-SF: Level of symptoms.

Interpretation of the above scores: five participants perceived a positive change, and one participant no change in symptoms. The mean of the six scores (*M* = -1.94), indicates that the treatment had a positive impact on perceived symptoms.

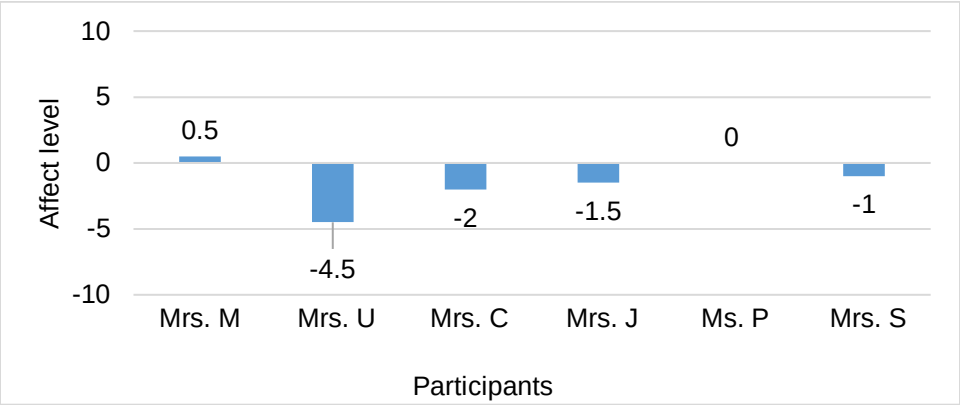

Figure 3. AIMS2-SF: Level of affect.

Interpretation of the above scores: four participants perceived a positive change, one participant no change, and one participant a negative change in affect. The mean of the six scores (*M* = -1.41), indicates that the treatment had a positive impact on perceived affect.

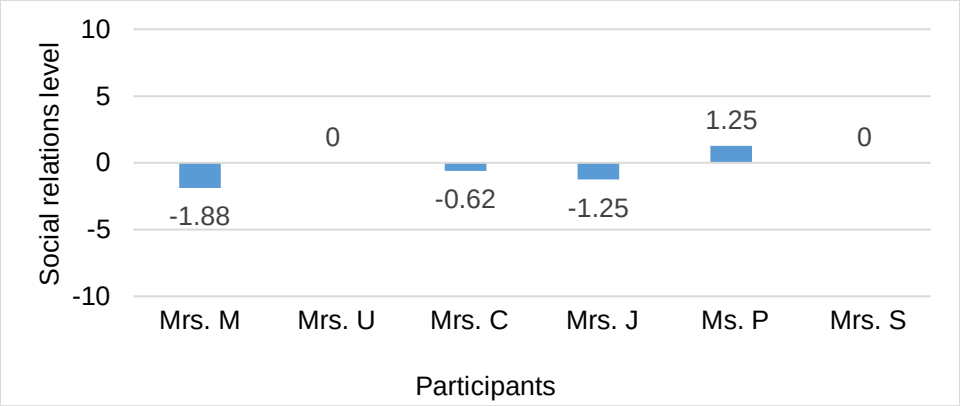

Figure 4. AIMS2-SF: Level of social relations.

Interpretation of the above scores: three participants perceived a positive change, two participants perceived no change, and one participant perceived a negative change in social

relations. The mean of the six scores (M = -0.42), indicates that the treatment had a small positive impact on perceived social relations.

Discussion

With respect to the four AIMS2-SF scales, all six participants had some amount of positive change in their perception of well-being. As to the amount of impact on perceived well-being due to engagement with the intervention, each individual's response was different with each AIMS-SF scale, indicating some ambiguity as to which scale conclusively showed a positive effect on well-being. Ranking of the AIMS2-SF scale means show that the intervention had the largest average positive impact on perceived symptoms: (M = -1.94); followed by affect: (M = -1.42); social relations: (M = -0.42); and the least positive impact on physical function: (M = -0.21). The results of this study indicate that a shallow-water functional movement intervention consisting of slow walking and stretching at light intensity, may have a positive impact on the well-being of older adult females with OA of the hip and or knee. These outcomes may translate to benefit the aquatic therapist or instructor, as well as, the individual.

Limitations

The study had a very small sample size, a larger sample may have had different outcomes. All of the participants were of Caucasian descent and female, the outcomes may have been different with a more heterogeneous sample. Because there were two different pools in which the treatment was conducted, there may have been less consistency than if the treatment had been conducted at one facility. Post-testing was conducted in a program room whereas pretesting was done in a conference room, this may have affected participant performance. For well-being, the study used a self-report instrument with the retrospective pretest method to avoid response shift bias. The collected data could be subjected to the problem of inadequate

information recall upon participant reflection of prior impressions. Participant bias could also be a limitation, as some of the participants could have answered the questions as they thought the investigator would have wanted. Participants may have also answered the questions in a way that would depict themselves in a socially favorable way. Some participants may have taken over the counter pain relievers, which may have influenced the perception of the level of their pain during the study. Also, there was no post treatment follow up to see if there was a lasting effect of the treatment, consequently a longer future study may be able to ascertain if the treatment has any long-term effect.

Conclusion

The goal of this study was to investigate the effect of an aquatic treatment with and without a stationary pole, on the well-being of older adult females with OA of the hip and or knee. Visual analysis of charts and comparison of participant mean score data, indicated an average positive effect of the intervention on participant perception of health related well-being. All of the averaged means of the six participants for each scale, showed a positive impact on well-being, indicating that the treatment may have had a small positive effect rather than a negative effect on perceived subjective well-being for symptoms, affect, social relations, and physical function. Because there was a sample size of six people, the outcomes and interpretations are not conclusive. Thus, generalization of the outcomes of this study should not be considered. It is suggested that this study be replicated with more participants, with the use of a two-group randomized controlled trial to refute or substantiate the preliminary outcomes of this study.

Chapter VI

DISCUSSION

Summary of Findings

This study consisting of a light intensity shallow-water functional movement program, conducted over a five week period, three sessions per week, 40 minutes each session, by older adult women with knee and or hip OA, indicated that the intervention had a positive effect on perceived pain, well-being, and physical function. Although, perceived impact of the intervention on self-efficacy, appeared to be contradictory.

Objective 1. This study sought to assess the effectiveness of the use of a functional movement intervention in shallow-water without the use of a stationary pole, by older adult women between the ages of 61 and 81, previously diagnosed with knee and or hip OA, to determine if the intervention affects perceived pain, compared to the engagement with the same functional movement intervention in shallow-water, with the stationary pole. Through visual analysis of the ExPRT graphed pain data, and comparison of the pre-crossover and post-crossover means, it was apparent there was no difference between the two treatments. This conclusion was confirmed with two statistical follow-up sensitivity analyses. Notwithstanding, analysis of the Excel 2013 graphed retrospective pretest and posttest primary pain data, indicated five out of six participants showed some improvement in perceived pain at posttest.

Objective 2. The purpose of this study was also to determine if functional movement in shallow-water had an effect on perceived well-being among older adult women between the ages of 61 to 81 who had previously been diagnosed with symptoms of knee and or hip OA. Visual analysis of charts and comparison of primary data collected with the AIMS2-SF, indicated a positive effect of the intervention on participant perceived subjective well-being. The averaged means of the six participants for each scale, indicated that the treatment may have had a positive

effect on perceived subjective well-being for physical function, symptoms, affect, and social interaction.

The findings of this study also indicated that a shallow-water functional movement intervention consisting of slow walking and stretching at light intensity, may have had a positive impact on upper and lower body flexibility, lower body strength, and dynamic balance and agility of older adult women with OA of the hip and or knee. Findings from the NGSE and PSEQ scores on general self-efficacy and pain self-efficacy, appear to be contradictory. Further research may help to explain participant adherence to the intervention regardless of their level of perceived general self-efficacy.

Limitations

The sample size of the study was small with six participants, and the length of the intervention was short at five weeks; a longer study with more participants could have provided different results. Because of limitations on time and resources, the baseline pain measures were taken over six consecutive days, making it difficult to establish true certainty of stability. As well, with participants exposed repeatedly to the same self-report measure, subsequent test scores could have been mistakenly interpreted as an effect of the treatment. Also, one threat to internal validity could influence participant response levels to other threats of internal validity (T. Kratochwill et al., 2010). The participants were all women and of Caucasian ancestry, the results might have been different if the sample were more diversified. Because the intervention was conducted at two facilities instead of one facility, the consistency of the instruction of the intervention may have been compromised. The pretesting was performed in a meeting room, whereas post-testing was performed in an exercise room, this could have affected the performance of the participants. The data collected with the retrospective pretest can be subject to a threat to internal validity of participant inadequate recall of information when reflecting back

on previous perceptions, as well as, regression to the mean (Lamb, 2005). The participants could have tried to answer the questionnaires to portray themselves in a socially acceptable light. As well, participants may have tried to please the investigator with answering questionnaires in a way that they thought the investigator wanted. Except for when the participants were blindly randomized to case-pairs, treatments, and crossover begin points, there was no other use of blinding for the study.

Because all of the participant's levels of pain were low at baseline, there may have been a floor effect where pain levels could not go much lower. Since the scores were so low, there was very little room for a decrease in pain levels. If the participants had higher pain levels at baseline, there may been no floor effect, allowing measurement of lower pain levels and thus more variability in pain data between baseline and intervention scores. As well, ExPRT analysis of the data was performed with retrospective pretest and posttest differenced scores, this procedure also lessened the variability of the data and was a limitation due to the narrow range of the data. It is just as possible that participant pain levels may have gotten better or worse on their own and not due to the intervention. Also, with the repeated measurement of pain, participants may have provided the same answer on subsequent testing out of boredom, habit, or fatigue (Verma, 2015).

For the study, there was no educational information imparted to the participants on the concept of self-efficacy nor strategies to improve their perceived self-efficacy. If self-efficacy education and improvement strategies had been implemented, it may have made a difference in the results of the study. Nonetheless, all of the participants stayed with the study until completion regardless of their level of general self-efficacy and pain self-efficacy. Research indicates that improving an individuals' perception of self-efficacy can increase adherence and

participation to a physical activity and has been identified consistently as having a central role with adherence to being physically active (Sherlock, 2014). The data on general self-efficacy and pain self-efficacy were contradictory, though data on pain self-efficacy indicated an improvement at posttest which may have affected participant adherence to the study despite symptoms of pain.

Implications for Practice

The findings from this investigation indicated that from participation with an aquatic functional movement program with or without a stationary pole, by older adult women with OA of the knee and or hip, there is preliminary empirical evidence that the intervention may help to reduce perceived pain, enhance health related well-being, improve lower body strength, upper and lower body flexibility, and basic agility and dynamic balance. These findings may provide practical information for the recreational or aquatic therapy professional, who could make a positive difference in an individual's level of pain and well-being that may be of benefit to the older adult woman with OA of the knee and or hip, as a cost effective nonpharmacological way to manage pain. Furthermore, because there was no discernable difference between the two treatments, the individual may find a personal preference for one or the other treatment. Thus, the recreational/aquatic therapist and the individual can determine which mode best fits the interests and strengths of the individual. For the recreational/aquatic therapy professional, and the individual who engages with an aquatic functional movement program, the findings indicate that the use of a stationary pole may not be any more effective on one's perception of pain and well-being than the functional movement program itself. This knowledge could ultimately result in a cost savings for the recreational/aquatic therapist and the individual.

The intervention was implemented in shallow-water at a depth of 3.50 feet, the following information provides the rationale for aquatic exercise in shallow-water that can aid the recreational/aquatic therapy practitioner. According to the Aquatic Exercise Associations' (AEA) sixth edition of the *Aquatic Fitness Professional Manual* (2010), a pool at a depth between 3.50 to 4.50 feet, is ideal for shallow-water aquatic exercise classes because this depth range can accommodate most participants of any height. Exercise in shallow-water is normally performed in water at a depth between the waist and the chest, in an upright position (*Aquatic fitness professional manual: The definitive resource for AEA certification and all-in-one reference guide*, 2010). Reports indicate that exercise in the water at waist to chest depth, can provide loads that are adequate for the improvement of flexibility, strength, and cardiovascular health (Sato et al., 2011). Exercise in shallow-water performed at a depth up to the level of the xiphoid process (chest), is where a participant can still propel oneself in the water through movements such as walking, stretching, squatting, or lunging while keeping their feet on the floor of the pool (Denning et al., 2012). The force of buoyancy minus the force of gravitation is referred to as the apparent weight of the human body while immersed in water. Ones' body weight on land is decreased by 50% in water up to ones' waist and decreased approximately 67% in water up to the xiphoid process (Orselli & Duarte, 2011). How deep one is immersed in water in relation to their height, influences the amount of unloading of the weight of the body, the force of buoyancy, and hydrostatic pressure. All of these aspects of water impact the behavior of one's movement and cardiopulmonary response while in the water (D'Acquisto, Miller, D'Acquisto, Roemer, & Fisher, 2015). Thus, aquatic exercise in shallow-water was the optimal level in which to perform the intervention, it was deep enough to significantly reduce the load on weight

bearing joints, at the same time, provide enough load to promote improvement in the physical abilities mentioned above.

Further studies could explore how self-efficacy and the SOC model may have a role in how participants with OA of the knee and or hip, adapt their movements to manage pain to stay with a recreational therapeutic aquatic exercise program. Studies with a larger, more heterogeneous sample, would increase the strength and the power of the outcomes. Also, a longer intervention period, and a post study follow-up, may be a way to determine if the intervention has a lasting effect. Conduction of a similar study with the instruction given to some participants individually and some participants instructed in small groups, may be a way to determine if socialization would have an effect on the outcomes of the study. To ensure the promotion of one's self-efficacy that may aid in participation to exercise, the inclusion of the development of one's skills, modeling of achievable behavior, and educational instruction is recommended (Sherlock, 2014). As well, the implementation of strategies that boost self-efficacy before the end of the intervention could help with adherence to a physical activity program after intervention (McAuley et al., 2011). Future studies on the effect of a functional movement program with the use of a stationary pole in shallow-water, could explore other populations, such as the effect of the intervention on children with developmental disabilities and their perception of happiness.

Conclusion

The purpose of the study was to examine the effect of an aquatic treatment with and without a stationary pole in shallow-water on pain and well-being of older adult women with OA of the hip and or knee. Visual analysis of charts and comparison of descriptive data, indicated no significant difference between the two conditions on pain. Although a positive effect of the

functional movement intervention itself on participant perceived pain, well-being, and physical function was indicated. Because there was a small sample size, over a short span of time, the outcomes and interpretations are not final. It is suggested that this study be reproduced with more participants, and of a longer duration with follow-up, to substantiate or contradict the preliminary outcomes of this study.

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Appendices

Appendix A

IRB Letter of Approval

INDIANA UNIVERSITY

OFFICE OF THE VICE PRESIDENT FOR RESEARCH

Office of Research Compliance

To: Jennifer Piatt
RECREATI
ON,PARK&
TOURISM
STUDIE

Mark
Saunders
RECREATIO
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From:

Chair - IRB-04
Human Subjects Office
Office of Research Compliance – Indiana University

Date: July 28, 2016

RE: **NOTICE OF EXPEDITED APPROVAL - NEW PROTOCOL**

Protocol Title: Effect of participation in shallow-water movements with the aid of a stationary aquatic pole on pain and well-being of adults 60 to 75 with knee or hip osteoarthritis.

Study #: 1509154025

Funding Agency/

Sponsor: None Review Level: Expedited

Status: Approved | Active - Open to Enrollment

Study Approval Date: July 28, 2016

Study Expiration Date: July 27, 2018

The Indiana University Institutional Review Board (IRB) IRB00000219 | IRB-04 recently reviewed the above-referenced protocol. In compliance with (as applicable) 21 CFR 56.109 (e), 45 CFR 46.109 (d), and IU Standard Operating Procedures (SOPs) for Research Involving Human Subjects, this letter serves as written notification of the IRB's determination.

Under 45 CFR 46.110, 45 CFR 56.110, and the SOPs as applicable, the study is approved under Expedited Category (4) Category 4: Collection of data through noninvasive procedures (not involving general anesthesia or sedation) routinely employed in clinical practice, excluding procedures involving x-rays or microwaves. Where medical devices are employed, they must be cleared/approved for marketing. (Studies intended to evaluate the safety and effectiveness of the medical device are not generally eligible for expedited review, including studies of cleared medical devices for new indications.) **(7)** Category 7: Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies. (NOTE: Some research in this category may be exempt from the HHS regulations for the protection of human subjects. 45 CFR 46.101(b)(2) and (b)(3). This listing refers only to research that is not exempt.)**, with the following determinations, as applicable:**

. Minimal Risk
. Waiver of informed consent for recruitment

Approval of this study is based on your agreement to abide by the policies and procedures of the Indiana University Human Research Protection Program and does not replace any other approvals that may be required. Relevant policies and procedures governing Human Subjects Research can be found at: http://researchcompliance.iu.edu/hso/hs_guidance.html.

IRB approval is required prior to implementing any changes or amendments in the protocol, regardless of how minor, except to eliminate immediate hazards to subjects. No changes to the informed consent document may be made without prior IRB approval.

Appendix B

Consent to Participate in Research Document

Consent to Participate in Research

Effect of participation in shallow-water movements with the aid of a stationary aquatic pole on the pain and well-being of adults 60 to 85 with knee or hip osteoarthritis.

You are being asked to participate in a research study:

Before you agree, there is information about the study that you need to know. You are invited to participate in a research study on the effect of shallow water movements on pain, balance, upper and lower body flexibility, lower body strength, and well-being. You were selected as a possible participant because you have osteoarthritis of the knee or hip and are between the ages of 60 and 85**.** Please read this form and ask any questions you may have before agreeing to be in the study.

Purpose of the Study:

The purpose of this study is to determine if a shallow-water functional movement treatment has an effect on physical function, perceived pain, and well-being among seven adults age 60 to 85 who have symptoms of knee or hip osteoarthritis.

Study Procedures:

The study is comprised of three segments

In the first segment prior to your participation in the study, you will be asked to fill out a hand written questionnaire testing your basic cognitive ability, you also will be asked to walk up a flight of stairs and walk approximately 300 feet without the use of crutches or assistance. This testing will occur during a three hour session in a gymnasium at the Monroe County YMCA Southeast (SE) facility 2125 S. Highland Ave. Bloomington Indiana, 47401. If you meet the requirements of this testing, you are eligible to participate in the study. You will then be tested for the measurement of your pain and basic mobility, balance, lower and upper body flexibility and lower body strength. You will also be asked to fill out a demographic questionnaire. Then for the following six days in the morning hours, you will receive one phone call at the same time each day, to report the level of your pain

The second segment is a five week, three days a week instruction of two water movement conditions in a shallow pool. Subjects who participate on Mondays, Wednesdays, and Saturdays will do so at the Monroe county YMCA SE facility in Bloomington Indiana 2125 S. Highland Ave., Bloomington IN, 47401. Subjects who participate on Tuesdays, Thursdays, and Saturdays will do so at the Monroe County YMCA at the Northwest facility 1375 N. Wellness Way, Bloomington IN, 47404. One condition is movements in the water with the aid of a stationary pole and the other condition is the same movements without the pole. The movement condition that you begin with, will be determined at random. You will then start individual instruction with one of the two movement conditions for a portion of the five weeks and then at a randomly determined session, switch to the other condition for the remainder of the five weeks. You will be given times and days where you will begin engagement with one of the conditions; three sessions per week, for 40 minutes each session. You will engage with a certified arthritis instructor and have an instructional video to watch, to guide you through the water movement program. During this segment of the study, in the morning hours before coming to each session, you will be called and asked over the telephone to report the level of your pain. This phone call will always be at the same time that we called you during the first segment of the study. Immediately after each daily session when you exit the pool, you will be asked to respond to the

pain chart as to how you felt prior to getting in the pool and asked to respond how you felt about your pain after you get out of the pool.

For the third segment, after the five week water movement treatment is over, you will meet with the researcher for a three hour session at a gymnasium at the Monroe County YMCA SE, for testing of your pain, your balance and basic mobility, lower and upper body flexibility and lower body strength. You will also be asked to fill out three questionnaires on your well-being, general self-efficacy, and pain self-efficacy. Lastly, the researcher will arrange a time and day to call you on the telephone for an informal interview that will be conducted within three days of this last three hour testing session. You will be asked to discuss with the researcher, your thoughts about your experience with the aquatic treatment of the study. You will be informed that the treatment has ended and that you can return to your normal daily life activities.
While in the study, the risks are:

It is anticipated that the magnitude of harm or discomfort from participating in the research study, are not greater in and of themselves than those encountered in ordinary daily life or during the performance of routine physical or psychological examinations or tests, you will be in a pool environment and the decks and entrances to the pool could be wet and present a risk of falling. It is possible that movement in the water could be a potential cause for pulled muscles or muscle soreness and or joint pain. You could also have the risk of feeling uncomfortable with answering some of the questions on the surveys that you will have to fill out. You will have a potential risk of losing your confidentiality while participating in the study at the facility where the study will be conducted. Your physical privacy will be protected as much as possible during participation in the study. Although, during participation in the study there is the potential for your privacy to be compromised. You will be pre-tested and post tested for pain, balance, mobility, flexibility and strength before beginning the aquatic treatment and tested on the same physical areas of measurements after the aquatic portion of the study, in a gymnasium at the Monroe County YMCA SE facility in Bloomington Indiana. Therefore, this area and the pool, are areas that just anyone could walk into and it possibly could be apparent to people walking in the area that you are taking part in research. Thus, other people may see the research activities and be aware of what you are doing. Even though this location is not one that I can make private, it will still be possible for you to communicate with the researcher without the conversation being easily overheard. There also may be other side effects that we cannot predict. Also, if an unforeseen medical condition should happen to you that would put you at risk, the researcher will ask that you halt your participation in the study.

While in the study, the benefits are:
The benefits to participation that are reasonable to expect are that you will have the opportunity try out a new way to facilitate your movement in the water that may be of benefit to your physical and psychological health. Also, from the results of your participation in the study, it is possible that there may be benefits to science and society.

Confidentiality:
Efforts will be made to keep your personal information confidential. We cannot guarantee absolute confidentiality. Your personal information may be disclosed if required by law. Your identity will be held in absolute confidence and not be revealed in reports in which the study may be published. Instead of being in the study, you have the option to choose not to participate in the study. Organizations that may inspect and/or copy your research records for quality assurance and data analysis include groups such as the study investigator and his/her research associates, the Indiana University Institutional Review Board or its designees, and (as allowed by

law) state or federal agencies, specifically the Office for Human Research Protections (OHRP)., who may need to access your medical and/or research records.

Payment:

You will be receiving compensation for gas to get to and from the YMCA, $10.00 for every session that you attend. This compensation will be in the form of a gift card given to you at the beginning session of each week for the previous week's attendance. At the end of the study, you will receive a $25.00 gift card for completing the study.

Compensation for injury:

In the event of physical injury resulting from your participation in this research, necessary medical treatment will be provided to you and billed as part of your medical expenses. Costs not covered by your health care insurer will be your responsibility. Also, it is your responsibility to determine the extent of your health care coverage. There is no program in place for other monetary compensation for such injuries. However, you are not giving up any legal rights or benefits to which you are otherwise entitled. If you are participating in research that is not conducted at a medical facility, you will be responsible for seeking medical care and for the expenses associated with any care received.

Voluntary nature of this study:

Taking part in this study is voluntary. You may choose not to take part or may leave the study at any time. Leaving the study will not result in any penalty or loss of benefits to which you are entitled. Your decision whether or not to participate in this study will not affect your current or future relations with Indiana University, the researchers for the study, or the people who work at the facility where the study will be held.

Participant's Consent

In consideration of all of the above, I give my consent to participate in this research study. I will be given a copy of this informed consent document to keep for my records. I agree to take part in this study.

If you agree to participate, you will be given a signed copy of this document and a written summary of the research after the completion of the study.
You may contact Jennifer A. Piatt Ph.D. at 812-855-7819; or Mark Saunders at 812-320-9252 at any time if you have questions about the research.
You may also contact the Institutional Review Board at 812-856-4242 if you have any questions about your rights as a research subject.

Participant's Printed Name:_____

Participant's Signature:_____**Date**:_____
(must be dated by the participant).

Printed Name of Person Obtaining Consent:_____

Signature of Person Obtaining Consent:_____**Date**:_____

Appendix C

Study Instruments

IU Aquatic Study Demographic Questionnaire Spring 2017

1. What is your age? _____

2. What is your gender? Female_____ Male_____

3. What is you height and weight? Height_____ Weight_____

4. What is the highest education level you have attained?
   - ☐ Primary School
   - ☐ High School or GED
   - ☐ Some college
   - ☐ 2-year associates degree
   - ☐ 4-year college degree
   - ☐ Graduate degree
   - ☐ Professional/terminal degree (MD, Ph.D., etc.)

5. What ethnicity do you identify with?
   - ☐ Native American or Aleut
   - ☐ Asian or Asian American
   - ☐ Black or African American
   - ☐ Hispanic; Latino/a or Latino/a American
   - ☐ Native Hawaiian
   - ☐ White/Caucasian or Caucasian American
   - ☐ Other (Please specify): _____

6. Marital status: Single ___Married____ Separated____ Divorced____Widowed____

7. Length of time with osteoarthritis: Years_____ Months_____

8. Please list all medications that you are currently using_____

   _____

   _____

9. Please list past surgeries:_____

   _____

   _____

10. Have you previously participated in an aquatic therapy program?

    ☐ Yes ☐No

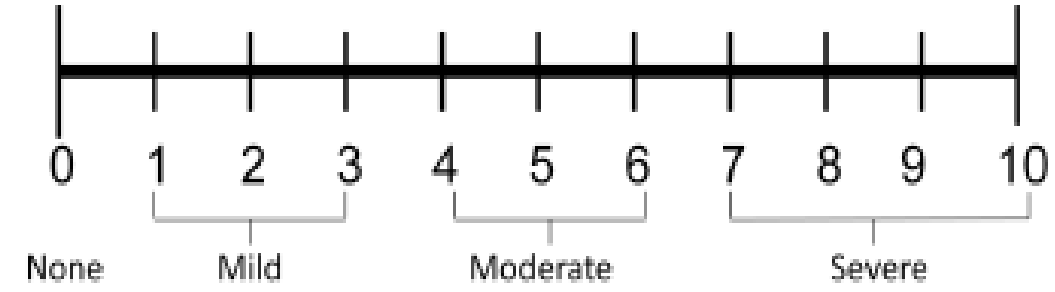
The Numeric Pain Rating Scale Instructions

General Information:

- The patient is asked to make three pain ratings, corresponding to current, best and worst pain experienced over the past 24 hours.
- The average of the 3 ratings was used to represent the patient's level of pain over the previous 24 hours.

Patient Instructions (adopted from (McCaffery, Beebe et al. 1989):

"Please indicate the intensity of current, best, and worst pain levels over the past 24 hours on a scale of 0 (no pain) to 10 (worst pain imaginable)"



Reference:

McCaffery, M., Beebe, A., et al. (1989). Pain: Clinical manual for nursing practice. Mosby St. Louis, MO.

2017 PAR-Q+

The Physical Activity Readiness Questionnaire for Everyone

The health benefits of regular physical activity are clear; more people should engage in physical activity every day of the week. Participating in physical activity is very safe for MOST people. This questionnaire will tell you whether it is necessary for you to seek further advice from your doctor OR a qualified exercise professional before becoming more physically active.

GENERAL HEALTH QUESTIONS

Please read the 7 questions below carefully and answer each one honestly: check YES or NO.	YES	NO
1) Has your doctor ever said that you have a heart condition ☐ OR high blood pressure ☐?	☐	☐
2) Do you feel pain in your chest at rest, during your daily activities of living, **OR** when you do physical activity?	☐	☐
3) Do you lose balance because of dizziness **OR** have you lost consciousness in the last 12 months? Please answer **NO** if your dizziness was associated with over-breathing (including during vigorous exercise).	☐	☐
4) Have you ever been diagnosed with another chronic medical condition (other than heart disease or high blood pressure)? **PLEASE LIST CONDITION(S) HERE:** _____	☐	☐
5) Are you currently taking prescribed medications for a chronic medical condition? **PLEASE LIST CONDITION(S) AND MEDICATIONS HERE:** _____	☐	☐
6) Do you currently have (or have had within the past 12 months) a bone, joint, or soft tissue (muscle, ligament, or tendon) problem that could be made worse by becoming more physically active? Please answer **NO** if you had a problem in the past, but it *does not limit your current ability* to be physically active. **PLEASE LIST CONDITION(S) HERE:** _____	☐	☐
7) Has your doctor ever said that you should only do medically supervised physical activity?	☐	☐

☑ **If you answered NO to all of the questions above, you are cleared for physical activity.**
Go to Page 4 to sign the PARTICIPANT DECLARATION. You do not need to complete Pages 2 and 3.

- Start becoming much more physically active – start slowly and build up gradually.
- Follow International Physical Activity Guidelines for your age (www.who.int/dietphysicalactivity/en/).
- You may take part in a health and fitness appraisal.
- If you are over the age of 45 yr and **NOT** accustomed to regular vigorous to maximal effort exercise, consult a qualified exercise professional before engaging in this intensity of exercise.
- If you have any further questions, contact a qualified exercise professional.

● **If you answered YES to one or more of the questions above, COMPLETE PAGES 2 AND 3.**

⚠ **Delay becoming more active if:**

- You have a temporary illness such as a cold or fever; it is best to wait until you feel better.
- You are pregnant - talk to your health care practitioner, your physician, a qualified exercise professional, and/or complete the ePARmed-X+ at **www.eparmedx.com** before becoming more physically active.
- Your health changes - answer the questions on Pages 2 and 3 of this document and/or talk to your doctor or a qualified exercise professional before continuing with any physical activity program.

2017 PAR-Q+

FOLLOW-UP QUESTIONS ABOUT YOUR MEDICAL CONDITION(S)

1.	**Do you have Arthritis, Osteoporosis, or Back Problems?** If the above condition(s) is/are present, answer questions 1a-1c	If **NO** ☐ go to question 2
1a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer **NO** if you are not currently taking medications or other treatments)	YES ☐ NO ☐
1b.	Do you have joint problems causing pain, a recent fracture or fracture caused by osteoporosis or cancer, displaced vertebra (e.g., spondylolisthesis), and/or spondylolysis/pars defect (a crack in the bony ring on the back of the spinal column)?	YES ☐ NO ☐
1c.	Have you had steroid injections or taken steroid tablets regularly for more than 3 months?	YES ☐ NO ☐
2.	**Do you currently have Cancer of any kind?** If the above condition(s) is/are present, answer questions 2a-2b	If **NO** ☐ go to question 3
2a.	Does your cancer diagnosis include any of the following types: lung/bronchogenic, multiple myeloma (cancer of plasma cells), head, and/or neck?	YES ☐ NO ☐
2b.	Are you currently receiving cancer therapy (such as chemotheraphy or radiotherapy)?	YES ☐ NO ☐
3.	**Do you have a Heart or Cardiovascular Condition?** *This includes Coronary Artery Disease, Heart Failure, Diagnosed Abnormality of Heart Rhythm* If the above condition(s) is/are present, answer questions 3a-3d	If **NO** ☐ go to question 4
3a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer **NO** if you are not currently taking medications or other treatments)	YES ☐ NO ☐
3b.	Do you have an irregular heart beat that requires medical management? (e.g., atrial fibrillation, premature ventricular contraction)	YES ☐ NO ☐
3c.	Do you have chronic heart failure?	YES ☐ NO ☐
3d.	Do you have diagnosed coronary artery (cardiovascular) disease and have not participated in regular physical activity in the last 2 months?	YES ☐ NO ☐
4.	**Do you have High Blood Pressure?** If the above condition(s) is/are present, answer questions 4a-4b	If **NO** ☐ go to question 5
4a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer **NO** if you are not currently taking medications or other treatments)	YES ☐ NO ☐
4b.	Do you have a resting blood pressure equal to or greater than 160/90 mmHg with or without medication? (Answer **YES** if you do not know your resting blood pressure)	YES ☐ NO ☐
5.	**Do you have any Metabolic Conditions?** *This includes Type 1 Diabetes, Type 2 Diabetes, Pre-Diabetes* If the above condition(s) is/are present, answer questions 5a-5e	If **NO** ☐ go to question 6
5a.	Do you often have difficulty controlling your blood sugar levels with foods, medications, or other physician-prescribed therapies?	YES ☐ NO ☐
5b.	Do you often suffer from signs and symptoms of low blood sugar (hypoglycemia) following exercise and/or during activities of daily living? Signs of hypoglycemia may include shakiness, nervousness, unusual irritability, abnormal sweating, dizziness or light-headedness, mental confusion, difficulty speaking, weakness, or sleepiness.	YES ☐ NO ☐
5c.	Do you have any signs or symptoms of diabetes complications such as heart or vascular disease and/or complications affecting your eyes, kidneys, **OR** the sensation in your toes and feet?	YES ☐ NO ☐
5d.	Do you have other metabolic conditions (such as current pregnancy-related diabetes, chronic kidney disease, or liver problems)?	YES ☐ NO ☐
5e.	Are you planning to engage in what for you is unusually high (or vigorous) intensity exercise in the near future?	YES ☐ NO ☐

2017 PAR-Q+

6. **Do you have any Mental Health Problems or Learning Difficulties?** *This includes Alzheimer's, Dementia, Depression, Anxiety Disorder, Eating Disorder, Psychotic Disorder, Intellectual Disability, Down Syndrome*

If the above condition(s) is/are present, answer questions 6a-6b — If **NO** ☐ go to question 7

6a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer **NO** if you are not currently taking medications or other treatments)	YES ☐ NO ☐
6b.	Do you have Down Syndrome **AND** back problems affecting nerves or muscles?	YES ☐ NO ☐

7. **Do you have a Respiratory Disease?** *This includes Chronic Obstructive Pulmonary Disease, Asthma, Pulmonary High Blood Pressure*

If the above condition(s) is/are present, answer questions 7a-7d — If **NO** ☐ go to question 8

7a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer **NO** if you are not currently taking medications or other treatments)	YES ☐ NO ☐
7b.	Has your doctor ever said your blood oxygen level is low at rest or during exercise and/or that you require supplemental oxygen therapy?	YES ☐ NO ☐
7c.	If asthmatic, do you currently have symptoms of chest tightness, wheezing laboured breathing, consistent cough (more than 2 days/week), or have you used your rescue medication more than twice in the last week?	YES ☐ NO ☐
7d.	Has your doctor ever said you have high blood pressure in the blood vessels of your lungs?	YES ☐ NO ☐

8. **Do you have a Spinal Cord Injury?** *This includes Tetraplegia and Paraplegia*

If the above condition(s) is/are present, answer questions 8a-8c — If **NO** ☐ go to question 9

8a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer **NO** if you are not currently taking medications or other treatments)	YES ☐ NO ☐
8b.	Do you commonly exhibit low resting blood pressure significant enough to cause dizziness, light-headedness, and/or fainting?	YES ☐ NO ☐
8c.	Has your physician indicated that you exhibit sudden bouts of high blood pressure (known as Autonomic Dysreflexia)?	YES ☐ NO ☐

9. **Have you had a Stroke?** *This includes Transient Ischemic Attack (TIA) or Cerebrovascular Event*

If the above condition(s) is/are present, answer questions 9a-9c — If **NO** ☐ go to question 10

9a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer **NO** if you are not currently taking medications or other treatments)	YES ☐ NO ☐
9b.	Do you have any impairment in walking or mobility?	YES ☐ NO ☐
9c.	Have you experienced a stroke or impairment in nerves or muscles in the past 6 months?	YES ☐ NO ☐

10. **Do you have any other medical condition not listed above or do you have two or more medical conditions?**

If you have other medical conditions, answer questions 10a-10c — If **NO** ☐ read the Page 4 recommendations

10a.	Have you experienced a blackout, fainted, or lost consciousness as a result of a head injury within the last 12 months **OR** have you had a diagnosed concussion within the last 12 months?	YES ☐ NO ☐
10b.	Do you have a medical condition that is not listed (such as epilepsy, neurological conditions, kidney problems)?	YES ☐ NO ☐
10c.	Do you currently live with two or more medical conditions?	YES ☐ NO ☐

PLEASE LIST YOUR MEDICAL CONDITION(S) AND ANY RELATED MEDICATIONS HERE: _____

_____

GO to Page 4 for recommendations about your current medical condition(s) and sign the PARTICIPANT DECLARATION.

2017 PAR-Q+

If you answered NO to all of the follow-up questions about your medical condition, you are ready to become more physically active - sign the PARTICIPANT DECLARATION below:

- It is advised that you consult a qualified exercise professional to help you develop a safe and effective physical activity plan to meet your health needs.
- You are encouraged to start slowly and build up gradually - 20 to 60 minutes of low to moderate intensity exercise, 3-5 days per week including aerobic and muscle strengthening exercises.
- As you progress, you should aim to accumulate 150 minutes or more of moderate intensity physical activity per week.
- If you are over the age of 45 yr and **NOT** accustomed to regular vigorous to maximal effort exercise, consult a qualified exercise professional before engaging in this intensity of exercise.

If you answered **YES** to **one or more of the follow-up questions** about your medical condition:

You should seek further information before becoming more physically active or engaging in a fitness appraisal. You should complete the specially designed online screening and exercise recommendations program - the **ePARmed-X+ at www.eparmedx.com** and/or visit a qualified exercise professional to work through the ePARmed-X+ and for further information.

Delay becoming more active if:

- You have a temporary illness such as a cold or fever; it is best to wait until you feel better.
- You are pregnant - talk to your health care practitioner, your physician, a qualified exercise professional, and/or complete the ePARmed-X+ **at www.eparmedx.com** before becoming more physically active.
- Your health changes - talk to your doctor or qualified exercise professional before continuing with any physical activity program.

- You are encouraged to photocopy the PAR-Q+. You must use the entire questionnaire and NO changes are permitted.
- The authors, the PAR-Q+ Collaboration, partner organizations, and their agents assume no liability for persons who undertake physical activity and/or make use of the PAR-Q+ or ePARmed-X+. If in doubt after completing the questionnaire, consult your doctor prior to physical activity.

PARTICIPANT DECLARATION

- All persons who have completed the PAR-Q+ please read and sign the declaration below.
- If you are less than the legal age required for consent or require the assent of a care provider, your parent, guardian or care provider must also sign this form.

I, the undersigned, have read, understood to my full satisfaction and completed this questionnaire. I acknowledge that this physical activity clearance is valid for a maximum of 12 months from the date it is completed and becomes invalid if my condition changes. I also acknowledge that a Trustee (such as my employer, community/fitness centre, health care provider, or other designate) may retain a copy of this form for their records. In these instances, the Trustee will be required to adhere to local, national, and international guidelines regarding the storage of personal health information ensuring that the Trustee maintains the privacy of the information and does not misuse or wrongfully disclose such information.

NAME _____ DATE _____

SIGNATURE _____ WITNESS _____

SIGNATURE OF PARENT/GUARDIAN/CARE PROVIDER _____

For more information, please contact
www.eparmedx.com
Email: eparmedx@gmail.com

Citation for PAR-Q+

Warburton DER, Jamnik VK, Bredin SSD, and Gledhill N on behalf of the PAR-Q+ Collaboration. The Physical Activity Readiness Questionnaire for Everyone (PAR-Q+) and Electronic Physical Activity Readiness Medical Examination (ePARmed-X+). Health & Fitness Journal of Canada 4(2):3-23, 2011.

Key References

1. Jamnik VK, Warburton DER, Makarski J, McKenzie DC, Shephard RJ, Stone J, and Gledhill N. Enhancing the effectiveness of clearance for physical activity participation: background and overall process. APNM 36(3):553-515, 2011.
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The PAR-Q+ was created using the evidence-based AGREE process (1) by the PAR-Q+ Collaboration chaired by Dr. Darren E. R. Warburton with Dr. Norman Gledhill, Dr. Veronica Jamnik, and Dr. Donald C. McKenzie (2). Production of this document has been made possible through financial contributions from the Public Health Agency of Canada and the BC Ministry of Health Services. The views expressed herein do not necessarily represent the views of the Public Health Agency of Canada or the BC Ministry of Health Services.

OSHF

01-01-2017

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CAST©
COGNITIVE ASSESSMENT SCREENING TEST

DIRECTIONS:

Using a **pencil**, fill out the answers to ***ALL*** questions that you can on the following **3 pages**. There is no penalty for guessing. Do **not** let anyone help you with the answers.

Put a **dash** if you cannot answer any question.

Part A

1. Name_____ (Last) (First) (Initial)

Address_____ (Street)

_____ (City, town) (State) (ZIP)

2. Today's Date:_____ (Month) (Day) (Year) Telephone (___)_____

3. Age:_____ Birthdate_____ (Month) (Day) (Year)

4. Highest grade in school_____

5. What is the name of this place?_____

6. Who is the : President of the U.S.?_____
Previous President?_____
Governor of your state?_____

7. On what continent is Brazil?_____

8. Copy this sentence in your own writing:
This is a lovely day in the month of May.

→ _____

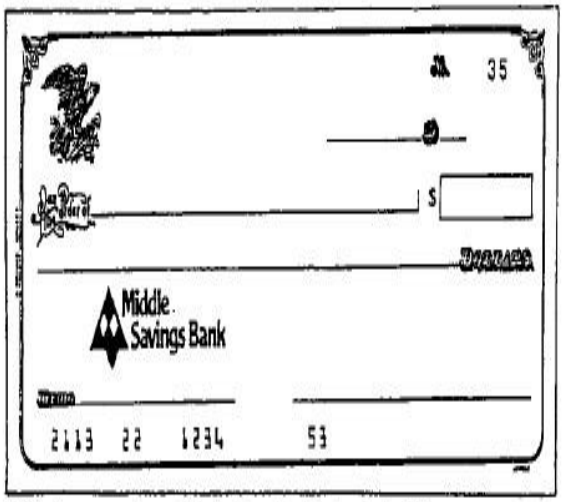
9. Copy the figure:	10. Draw a Person:
	

Part B

1- Add the following numbers:

$112.59
37.64
5.97
82.50
_____

2- Fill out the following check to American Telephone Co. for $137.68:



3- Fill in the numerals on this clock, and set the hands to 1:45:

4- Copy this figure-

5- The Vice President of the U.S. is: _____
The Senators of your state are: _____
_____

Part C

1. Are you increasingly forgetting important things, that are interfering with your normal activities (eg, the day, date; recent conversations)-more than others your own age? Yes__ No__

2. Are you losing track of things that you used to know well, like family events, and news events or sports? Yes__ No__

3. Are you often unable to find even common words or familiar names, so that you find it difficult to have a normal conversation? Yes__ No__

4. Are you having trouble understanding what people say, or what they mean, though your hearing is good? Yes__ No__

5. Are you having trouble following the plots of books, TV shows or movies? Yes__ No__

6. Have you become lost or confused when driving or walking in a familiar place? Yes__ No__

7. Are you having increasing trouble carrying out everyday activities, such as paying bills, writing checks, cooking meals, doing simple repairs? Yes__ No__

8. Are you unable to keep up your hobbies or activities because they have become too confusing (card-games, Bingo, sewing, woodwork)? Yes__ No__

9. Are you becoming overwhelmed by simple tasks that you used to complete in a short time? Yes__ No__

10. Are others (spouse, children) taking over personal activities that you ordinarily would do (shopping, cleaning, banking, writing cards)? Yes__ No__

11. Have you lost interest in going places, doing things, seeing people that you previously enjoyed? Yes__ No__

12. Do you or others think that your personality, character or behavior have changed? Yes__ No__

13. If you have noted changes - have they been increasing over time? Yes__ No__

30 Second Chair Stand Test

Purpose

To assess lower body strength.

Equipment

Stopwatch and straight-back or folding chair with a seat height of 17 inches (43cm); chair is placed against a wall to prevent slipping.

Procedure

Instruct the participant to sit in the middle of the chair with back straight, feet flat on the floor, and arms crossed at the wrists and held against the chest. On the signal "go", the participant rises to a full stand, then returns to a fully seated position. Before testing, have the participant practice one or two stands. Demonstrate the test slowly to show proper form, then at a faster pace to show that the objective is to do the best one can within safety limits. Encourage the participant to complete as many full stands as possible in 30 seconds (Rikli & Jones, p. 64).

Scoring

The score is the total number of stands completed in 30 seconds. If a person is more than halfway up at the end of 30 seconds, it counts as a full stand. Administer only one test trial.

Safety Precautions

- Brace the chair against the wall, or have someone hold it steady. Ideally, use a carpeted surface for the chair to further keep it from slipping away from its position.
- Watch that the chair is under the participants when they sit, especially for people who are visually impaired or physically and cognitively frail.
- Watch for balance problems; quick movement could especially increase instability for people with sensory impairments (e.g., vision, or inner ear problems).
- This test item may be contraindicated for people with chronic pain disorders and tall people who have had a knee or hip replacement (using a 17-inch chair may cause an angle greater than 90 degrees at the hips and knees, causing additional strain). Adapt the test to reduce pain or improve the angle, or do not use the test.

Adaptations for Special Populations

- If participants cannot perform even one stand with arms crossed on the chest, allow them to use their hands to push off their legs or the chair, or use a cane or walker, or use a higher or lower seat height. Describe the exact adaptation on the scorecard (e.g., pushed off thighs, used chair to push off, adjusted seat height up or down [note inches]). Although the recorded test score is zero for purposes of comparing to normative

standards, also indicate the adapted score (i.e., 0/14) so that personal performance can be evaluated from one test time to the next. Of course the goal is to eventually use the test protocol as written, which doesn't allow using hands to press off.

- Remember, although the test protocol is the number of stands in 30 seconds, the test time can stop once you observe the person is no longer able to perform additional stands.
- For the cognitively impaired, you may want to repeat the test item demonstration.

If the person is rather frail, she does not have to perform a practice stand (Rikli & Jones, pp. 64-65).

Chair Sit-and-Reach Test

Purpose

To assess lower-body (primarily hamstring) flexibility.

Equipment

Folding chair with a seat height of 17 inches (43cm) and with legs that angle forward to prevent tipping, and an 18-inch (46 cm) ruler (half a yardstick); chair is placed against a wall to prevent slipping.

Procedure

The participant sits on the edge of the chair. The crease between the top of the leg and the buttocks should be even with the front edge of the chair seat. One leg is bent and slightly off to one side with the foot flat on the floor. The other leg is extended as straight as possible in front of the hip. The heel is placed on the floor, with the foot flexed at approximately 90 degrees.

With arms outstretched, hands overlapping, and middle fingers even, that participant slowly bends forward at the hip joint, reaching as far as possible toward or past the toes. If the extended knee starts to bend, ask the participant to move slowly back until the knee is straight. The maximum reach must be held for two seconds.

The participant should practice the test on both legs to see which is preferred (the one resulting in the better score). Only the preferred leg is used for scoring purposes (for comparison with norms). Once the preferred leg is determined, have the participant practice a couple of more times for warm-up.

Scoring

After the participant has had two practice trials on the preferred leg, administer two test trials and record the better test score. Measure the distance from the tips of the middle fingers to the toe end of the shoe to the nearest half inch (centimeter). The midpoint at the toe end of the shoe represents the zero point. If the reach is short of this point, record the distance as a minus (-)

score; if the middle fingers tough the toes, record a score of zero; and if the reach is past the midpoint of the toes, record the distance as a plus (+) score.

Safety Precautions

- Place the chair securely against a wall so it doesn't slip during testing.
- Remind participants to exhale as they bend slowly forward and to avoid bouncing.
- Participants should stretch only to a point of slight discomfort, never to the point of pain.
- Remind participants not to hold their breath – just continue breathing throughout the test.
- Do not administer the test to people with severe osteoporosis, with recent knee or hip replacements, or who have pain when flexing forward.
- Tester should get down beside the participant to the outside of the extended leg and place one hand on the knee (gently) so that if the tester feels the knee start to bend, she can have the participant stop or pull back if necessary.

Adaptation for Special Populations

- For people who cannot fully extend the knee, note approximate flexion on the scorecard, using a goniometer (if available) or using best judgement. The goniometer, if used, is positioned on the outside of the extended leg with the center axis at the midpoint of the knee joint, with one arm of the goniometer placed in line with the femur and one arm in line with the middle of the lower leg.
- If a participant is visually impaired, ask if you can touch him to help direct him.
- Repeat the demonstration for people who have a difficult time following directions.
- Allow participants to perform the test from a wheelchair (with wheels locked) or a walker with a seat (Rikli & Jones, pp. 71-72).

Back Scratch Test

Purpose

To assess upper-body (shoulder) flexibility.

Equipment

18-inch (46 cm) ruler.

Procedure

Have the participant stand and place the preferred hand over the same shoulder, palm down and fingers extended, reaching down the middle of the back as far as possible. Note that the elbow is pointes up. Ask the participant to place the other arm around the back of the waist with the palm up, reaching up the middle of the back as far as possible in an attempt to touch or overlap the extended fingers of both hands. The participant should practice the test to determine the

preferred position (the hand over the shoulder that produces the best score). Two practice trials are given before scoring the test.

Check to see if the middle fingers are directed toward each other as best as possible. Without moving the participant's hands, direct the middle fingers to the best alignment. Do not allow participants to grab their fingers together and pull.

Scoring

After giving the participant two warm-up practice trials in the preferred position, administer two test trials and record the better test score to the nearest half inch (cm), measuring the distance of overlap, or distance between, the tips of the middle fingers. Give a minus (-) score if the middle fingers do not touch, a zero score if the middle fingers just barely touch, and a plus (+) score if the middle fingers overlap. Always measure the distance from the tip of one middle finger to the tip of the other, regardless of their alignment behind the back.

Safety Precautions

- Stop the test if the participant experiences pain.
- Remind the participants to continue breathing as they stretch.
- Remind the participants to avoid any bouncing or rapid movements.
- Try to take the measurement as quickly as possible so participants don't have to hold an uncomfortable position.
- Have participants shake and roll their shoulders between trials.

Adaptations for Special Populations

- This test is contraindicated for people with neck and shoulder injuries or problems (e.g., frozen shoulder, rotator cuff problems, and pinched nerves):(Rikli & Jones, p. 73).

8-Foot-Up-and-Go Test

Purpose

To assess agility and dynamic balance.

Equipment

Stopwatch, folding chair with 17 inch (43 cm) seat height, tape measure, and cone (or similar marker).

Setup

Place the chair against the wall, facing a cone marker exactly 8 feet (2.4 m) away, measured from the back of the cone to a point on the floor even with the front edge of the chair.

Procedure

Instruct the participant to sit in the middle of the chair with back straight, feet flat on the floor, and hands on the thighs. One foot should be slightly in front of the other foot, with the torso slightly leaning forward. On the signal "go" the participant get up from the chair, walks as quickly as possible around either side of the cone, and sits back down in the chair. Be sure to start the timer on the signal "go" whether or not the participant has started to move, and stop the timer at the exact instant the person sits back down on the chair.

Scoring

After you have demonstrated the proper form and desired pace, have the participant practice the test once, and then administer two test trials. Record the best (fastest) time to the nearest tenth of a second.

Safety Precautions

- When administering the 8-foot-up-and-go test, stand between the chair and cone in order to assist participants in case they lose their balance. For the frail, you may need to spot them more closely, especially as they stand, turn around the cone, and sit down. If at any time you believe a person is at risk for falling, do not administer the test.
- With the frail or very obese person, watch that he stands up and sits down safely; you may have to direct the person's bottom to the chair as he sits down. Also, you may need to use a larger and sturdier chair and possibly get assistance from a strong person.

Adaptations for Special Populations

- If needed, participants can use a cane or walker for this test.
- For the visually impaired, use a brightly colored or larger cone to prevent tripping; provide verbal guiding cues, and, if needed, physically guide the participant.
- For the cognitively impaired, mark the walking path with markers or arrows.
- Allow people who are unable to get up from a chair to start and stop the test from a standing position (Rikli & Jones, pp. 74-75).

Reprinted, with permission, from R.E. Rikli and C.J. Jones, 2013, *Senior Fitness Test manual,* 2nd ed. (Champaign, IL: Human Kinetics), pp. 64-65 [or 71-72 or 73 or 74-75].

Arthritis Impact Measurement Scales 2 (AIMS2-SF)

During the past four weeks …	All Days	Most Days	Some Days	Few Days	No Days
1. How often were you physically able to drive a car or use public transportation?	☐	☐	☐	☐	☐
2. How often were you in a bed or chair for most of the day?	☐	☐	☐	☐	☐
3. Did you have trouble doing vigorous activities such as running, lifting heavy objects, or participating in strenuous sports?	☐	☐	☐	☐	☐
4. Did you have trouble either walking several blocks or climbing a few flights of stairs?	☐	☐	☐	☐	☐
5. Were you unable to walk unless assisted by another person or by a cane, crutches or walker?	☐	☐	☐	☐	☐
6. Could you easily write with a pen or pencil?	☐	☐	☐	☐	☐
7. Could you easily button a shirt or blouse?	☐	☐	☐	☐	☐
8. Could you easily turn a key in a lock?	☐	☐	☐	☐	☐
9. Could you easily comb or brush your hair?	☐	☐	☐	☐	☐
10. Could you easily reach shelves that were above your head?	☐	☐	☐	☐	☐
11. Did you need help to get dressed?	☐	☐	☐	☐	☐
12. Did you need help to get out of bed?	☐	☐	☐	☐	☐
13. How often did you have severe pain from your arthritis?	☐	☐	☐	☐	☐
14. How often did your morning stiffness last more than one hour from the time you woke up?	☐	☐	☐	☐	☐
15. How often did your pain make it difficult for you to sleep?	☐	☐	☐	☐	☐
16. How often have you felt tense or high strung?	☐	☐	☐	☐	☐

17. How often have you been bothered by nervousness or your nerves?	☐	☐	☐	☐	☐
18. How often have you been in low or very low spirits?	☐	☐	☐	☐	☐
19. How often have you enjoyed the things you do?	☐	☐	☐	☐	☐
20. How often did you feel like a burden to others?	☐	☐	☐	☐	☐
21. How often did you get together with friends or relatives?	☐	☐	☐	☐	☐
22. How often were you on the telephone with close friends or relatives?	☐	☐	☐	☐	☐
23. How often did you go to a meeting of a church, club, team, or other groups?	☐	☐	☐	☐	☐
24. Did you feel that your family or friends were sensitive to your personal needs?	☐	☐	☐	☐	☐

If you are unemployed, disabled, or retired, stop here.

25. How often were you unable to do any paid work, house work or school work?	☐	☐	☐	☐	☐
26. On the days you did work, how often did you have to work a shorter day?	☐	☐	☐	☐	☐

New General Self-Efficacy Scale (NGSE)

To what extent does each statement describe you? Indicate your level of agreement by marking the appropriate response.

1. I will be able to achieve most of the goals that I have set for myself.

Strongly Agree___ Agree ___Neutral ___Disagree ___Disagree Strongly___

2. When facing difficult tasks, I am certain that I will accomplish them.

Strongly Agree___ Agree ___Neutral ___Disagree ___Disagree Strongly___

3. In general, I think that I can obtain outcomes that are important to me.

Strongly Agree___ Agree ___Neutral ___Disagree ___Disagree Strongly___

4. I believe I can succeed at most any endeavor to which I set my mind.

Strongly Agree___ Agree ___Neutral ___Disagree ___Disagree Strongly___

5. I will be able to successfully overcome many challenges.

Strongly Agree___ Agree ___Neutral ___Disagree ___Disagree Strongly___

6. I am confident that I can perform effectively on many different tasks.

Strongly Agree___ Agree ___Neutral ___Disagree ___Disagree Strongly___

7. Compared to other people, I can do most tasks very well.

Strongly Agree___ Agree ___Neutral ___Disagree ___Disagree Strongly___

8. Even when things are tough, I can perform quite well.

Strongly Agree___ Agree ___Neutral ___Disagree ___Disagree Strongly___

Pain Self-Efficacy
Questionnaire PSEQ

Items

NAME: _____ DATE: _____

Please rate how **confident** you are that you can do the following things at present, **despite the pain**.

To indicate your answer circle **one** of the numbers on the scale under each item, where 0 = *not at all confident* and 6 = *completely confident*.

For example:

0 1 2 3 4 5 6

Not at all Confident — Completely confident

---

1. I can enjoy things, despite the pain.

0 1 2 3 4 5 6

Not at all Confident — Completely confident

2 . I can do most of the household chores (e.g., tidying-up, washing dishes, etc.), despite the pain.

0 1 2 3 4 5 6

Not at all Confident — Completely confident

3. I can socialise with my friends or family members as often as I used to do, despite the pain.

0 1 2 3 4 5 6

Not at all Confident — Completely confident

4. I can cope with my pain in most situations.

0 1 2 3 4 5 6

Not at all Confident — Completely Confident

Pain Self-Efficacy
Questionnaire PSEQ

Items

5. I can do some form of work, despite the pain. ("work" includes housework, paid and unpaid work).

0	1	2	3	4	5	6
Not at all Confident						Completely confident

6. I can still do many of the things I enjoy doing, such as hobbies or leisure activity, despite pain.

0	1	2	3	4	5	6
Not at all Confident						Completely confident

7. I can cope with my pain without medication.

0	1	2	3	4	5	6
Not at all Confident						Completely confident

8. I can still accomplish most of my goals in life, despite the pain.

0	1	2	3	4	5	6
Not at all Confident						Completely confident

9. I can live a normal lifestyle, despite the pain.

0	1	2	3	4	5	6
Not at all Confident						Completely confident

10. I can gradually become more active, despite the pain.

0	1	2	3	4	5	6
Not at all Confident						Completely confident

Appendix D

Instrument Permissions

Dear Mark , on behalf of the PAR-Q+ Collaboration I am pleased to hear that you have found our resource to be useful. I would like to confirm that you have our permission to include the Physical Activity Readiness Questionnaire for Everyone (PAR-Q+) in your work. There is no cost to include our document in your publication. We simply ask that you use our official document (as found at www.eparmedx.com). Please be sure to use the official PAR-Q+ (2017 PAR-Q+) as there are other unofficial and non-approved versions. The actual PAR-Q+ can be only found at www.eparmedx.com (and the Health & Fitness Journal of Canada). We also ask that appropriate acknowledgement to our work is made including reference to the official site for the PAR-Q+ and ePARmed-X+ (www.eparmedx.com) and the citations for the work. Therefore, please acknowledge the original sources and include the following credit line: "Reprinted with permission from the PAR-Q+ Collaboration (www.eparmedx.com) and the authors of the PAR-Q+ (Dr. Darren Warburton, Dr. Norman Gledhill, Dr. Veronica Jamnik, Dr. Roy Shephard, and Dr. Shannon Bredin).
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Thank you,

Darren

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Email: darren.warburton@ubc.ca

Mark,

You have my permission to use the Cognitive Assessment Screening Test for your study.

Joan M. Swearer, PhD, ABPP-CN
Professor of Clinical Neurology and Psychiatry
University of Massachusetts Medical School
55 Lake Avenue North
Worcester, MA 01655
telephone: 508-856-5668
fax: 508-856-3160
email: joan.swearer@umassmemorial.org

HUMAN KINETICS
1607 North Market Street • P.O. Box 5076 • Champaign IL 61825-5076 (217) 351-5076 • Fax (217) 351-2674

August 14, 2017

Mark Saunders
School of Public Health
Indiana University
PH 199
Bloomington, IN 47406

RE: Request to reprint the text describing the 30-Second Chair Stand Test (pages 64-65), Chair Sit-and-Reach Test (pages 71-72), Back Scratch Test (page 73), and 8-Foot Up-and-Go Test (pages 74-75), in *Senior Fitness Test Manual, Second Edition*, by Roberta E. Rikli and C. Jessie Jones in the appendices to your PhD dissertation at Indiana University [ID #14865]

Dear Mr. Saunders:

We are pleased to approve your permission request for one-time use of the text describing the 30-Second Chair Stand Test (pages 64-65), Chair Sit-and-Reach Test (pages 71-72), Back Scratch Test (page 73), and 8-Foot Up-and-Go Test (pages 74-75) as published in *Senior Fitness Test Manual, Second Edition,* in your PhD dissertation at Indiana University. This is your confirmation that we are granting nonexclusive print and electronic rights, for worldwide distribution, contingent upon your use of the following credit line adjacent to the reprinted material.

CREDIT LINE:

Reprinted, with permission, from R.E. Rikli and C.J. Jones, 2013, *Senior Fitness Test manual,* 2nd ed. (Champaign, IL: Human Kinetics), 64-65 [or 71-72 or 73 or 74-75].

FEE: WAIVED

In the future, should you wish to formally publish this material, please request permission again.

Sincerely,

Martha Gullo

Martha Gullo
Permissions Coordinator
Ph: 217-351-5076 ext. 2223
Email: marthag@hkusa.com

Guillemin F, Coste J, Pouchot J, Ghezail M, Bregeon C, Sany J. The AIMS2-SF: a short form of the Arthritis Impact Measurement Scales 2. French Quality of Life in Rheumatology Group. Arthritis Rheum. 1997 Jul;40(7):1267-74

CONTACT AND CONDITIONS OF USE

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E-mail: francis.guillemin@univ-lorraine.fr

Conditions of use

- [x] free access
- [ ] with author's written permission
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- [ ] with fees for commercial/pharmaceutical companies
- [ ] with the signature of a contract/agreement
- [ ] other

New General Self-Efficacy Scale

PsycTESTS Citation:
Chen, G., Gully, S. M., & Eden, D. (2001). New General Self-Efficacy Scale [Database record]. Retrieved from PsycTESTS. doi: 10.1037/t08800-000

Test Shown: Full

Test Format:
The measure's 8 items are rated on a 5-point Likert-type scale from strongly disagree (1) to strongly agree (5).

Source:
Chen, Gilad, Gully, Stanley M., & Eden, Dov. (2001). Validation of a new general self-efficacy scale. Organizational Research Methods, Vol 4(1), 62-83. doi: 10.1177/109442810141004, © 2001 by SAGE Publications. Reproduced by Permission of SAGE Publications.

Pain Self-Efficacy Questionnaire
Version Attached: Full Test

PsycTESTS Citation:
Nicholas, M. K. (1989). Pain Self-Efficacy Questionnaire [Database record]. Retrieved from PsycTESTS. doi: http://dx.doi.org/10.1037/t23216-000

Instrument Type:
Inventory/Questionnaire

Test Format:
Each item is rated by selecting a number on a 7-point scale, where 0 equals "not at all confident" and 6 equals "completely confident". A total score is calculated by summing the scores for each of the 10 items, yielding a maximum possible score of 60. Higher scores reflect stronger self-efficacy beliefs.

Source:
Nicholas, Michael K. (2007). The pain self-efficacy questionnaire: Taking pain into account. European Journal of Pain, Vol 11(2), 153-163. doi: 10.1016/j.ejpain.2005.12.008, © 2007 by Elsevier. Reproduced by Permission of Elsevier.

Appendix E

Video Clips of Functional Movement Positions

The following figures are short video clips of each of the 16 aquatic functional movements incorporated into the intervention exercise protocol.

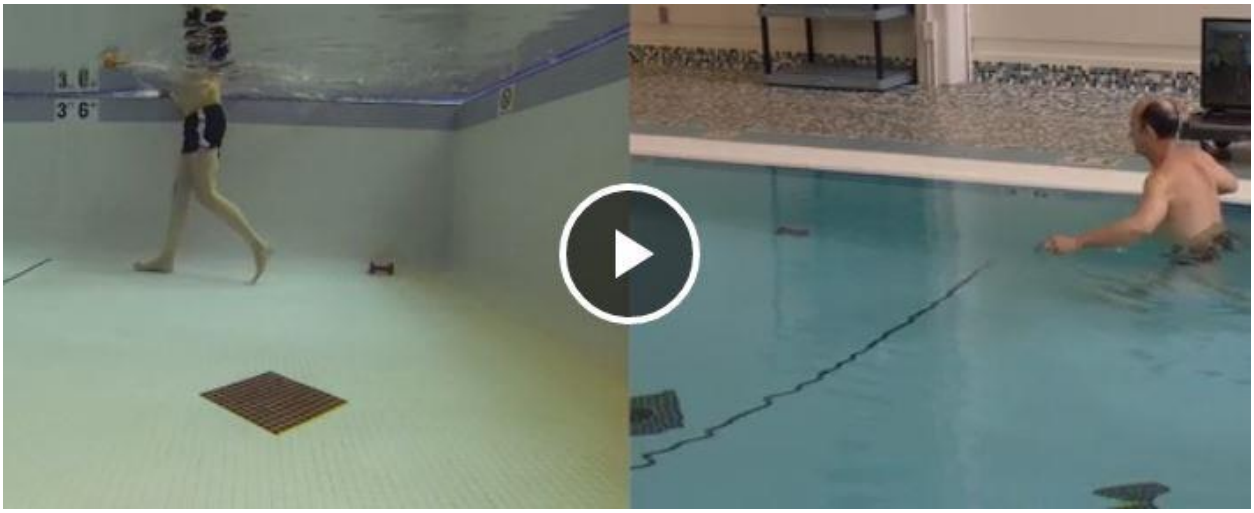

Figure D.1. Walk forward turn around movement along wall.

Figure D.2. Walk forward turn around movement with pole.

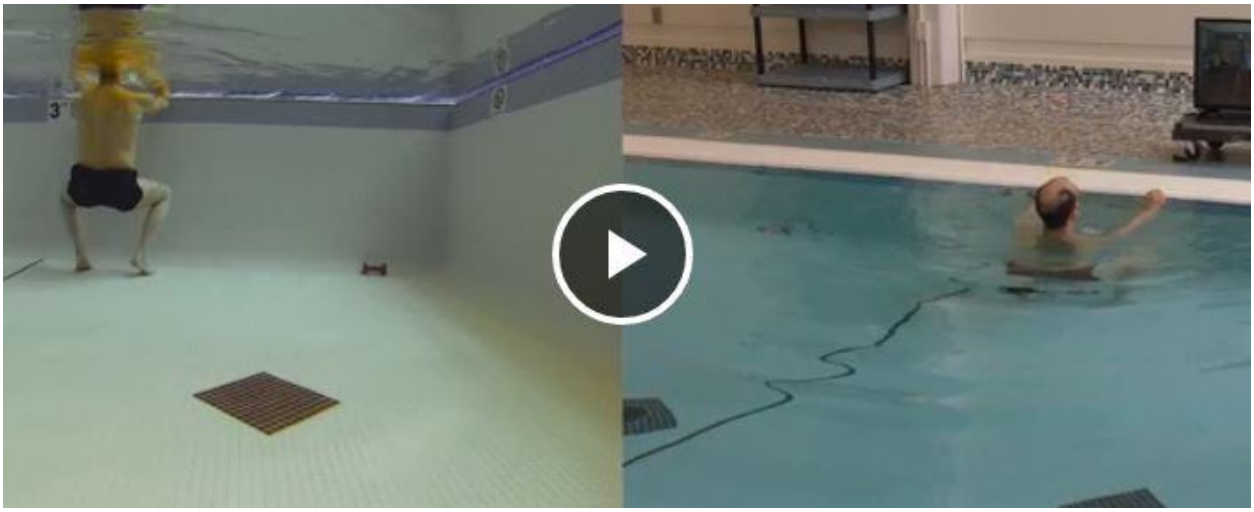

Figure D.3. Squats movement at wall.

Figure D.4. Squats movement with pole.

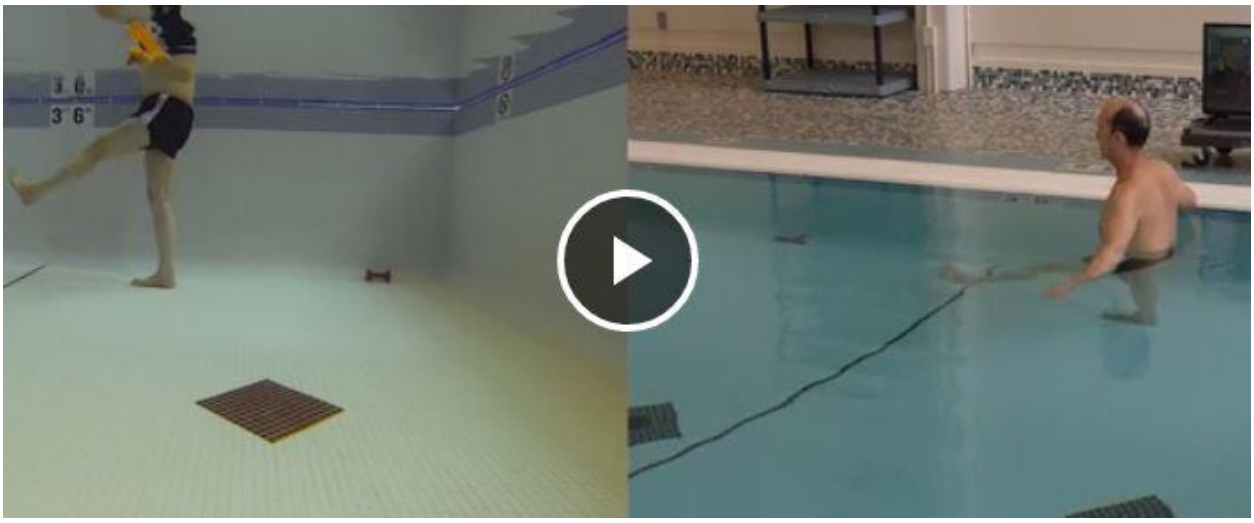

Figure D.5. Hip flexion movement at wall.

Figure D.6. Hip flexion movement with pole.

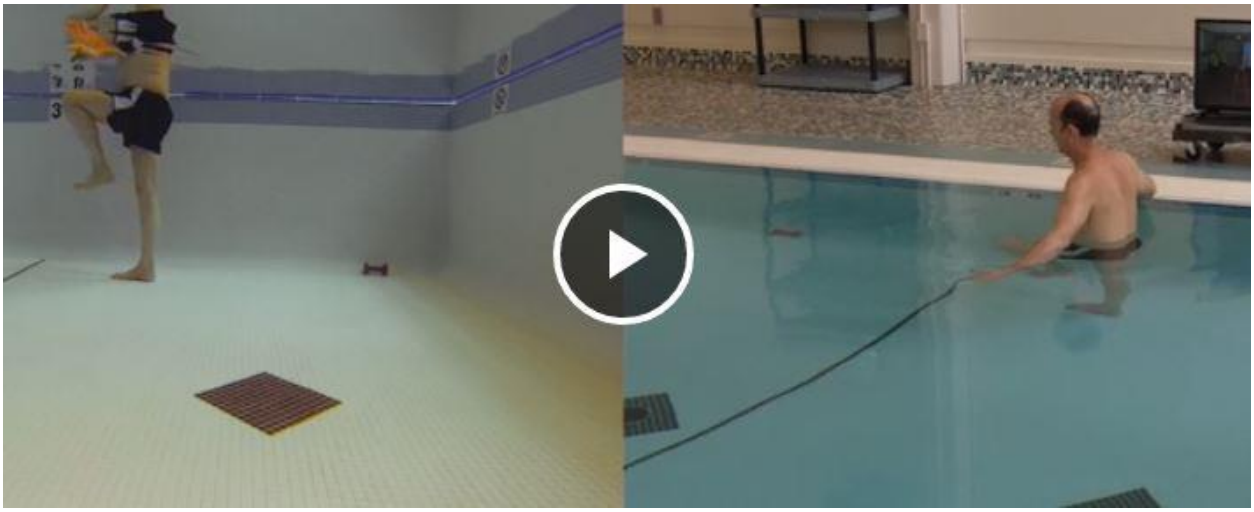

Figure D.7. Knee flexion movement at wall.

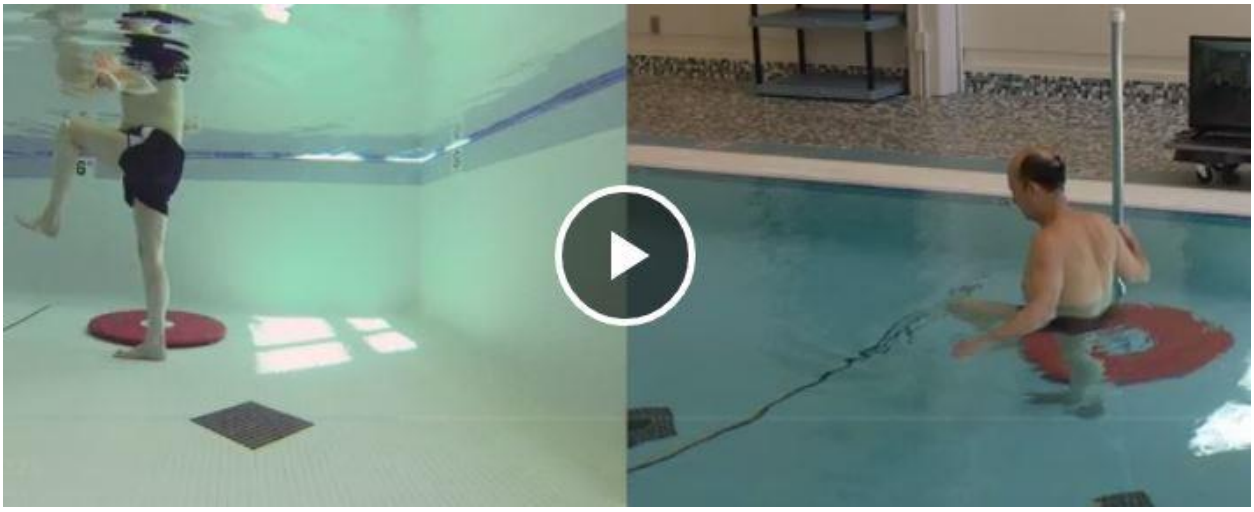

Figure D.8. Knee flexion movement with pole.

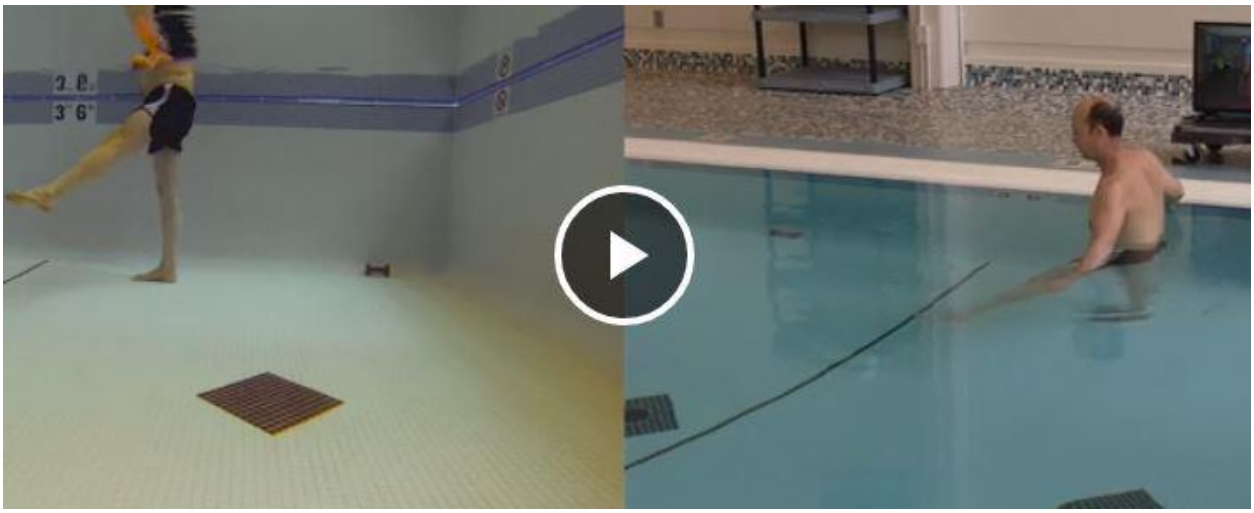

Figure D.9. Hip circumduction movement at wall.

Figure D.10. Hip circumduction movement with pole.

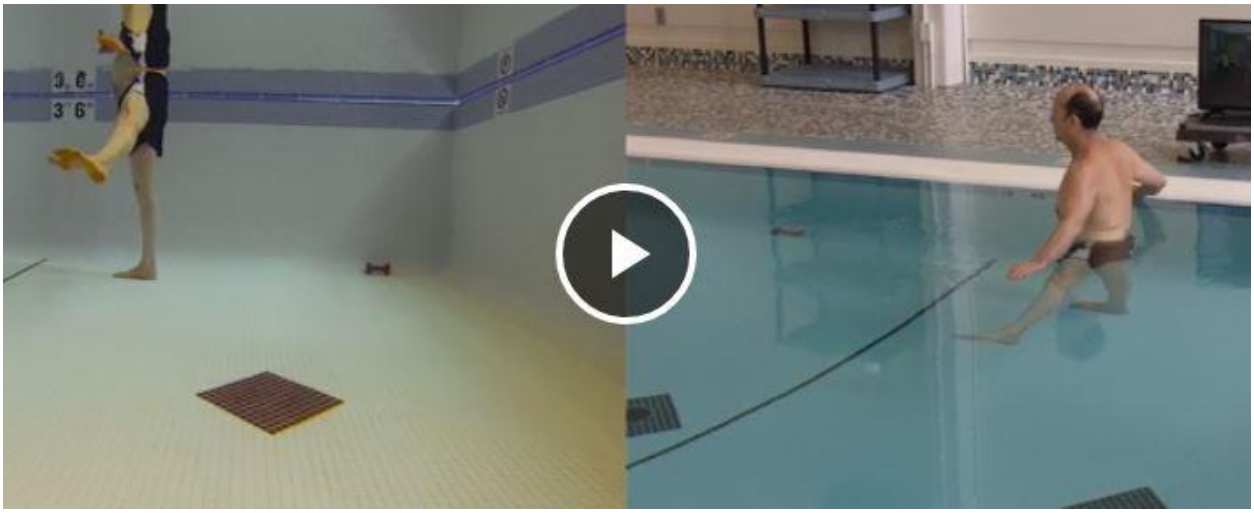

Figure D.11. Hip abduction/adduction movement at wall.

Figure D.12. Hip abduction/adduction movement with pole.

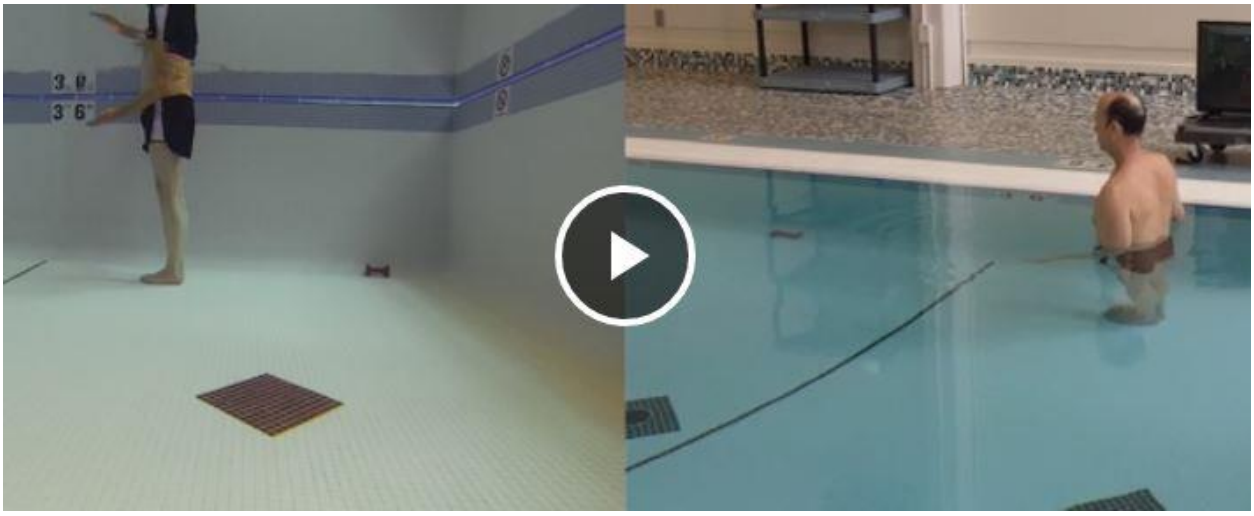

Figure D.13. Tricep/bicep elbow flexions movement at wall.

Figure D.14. Tricep/bicep elbow flexion movement with pole.

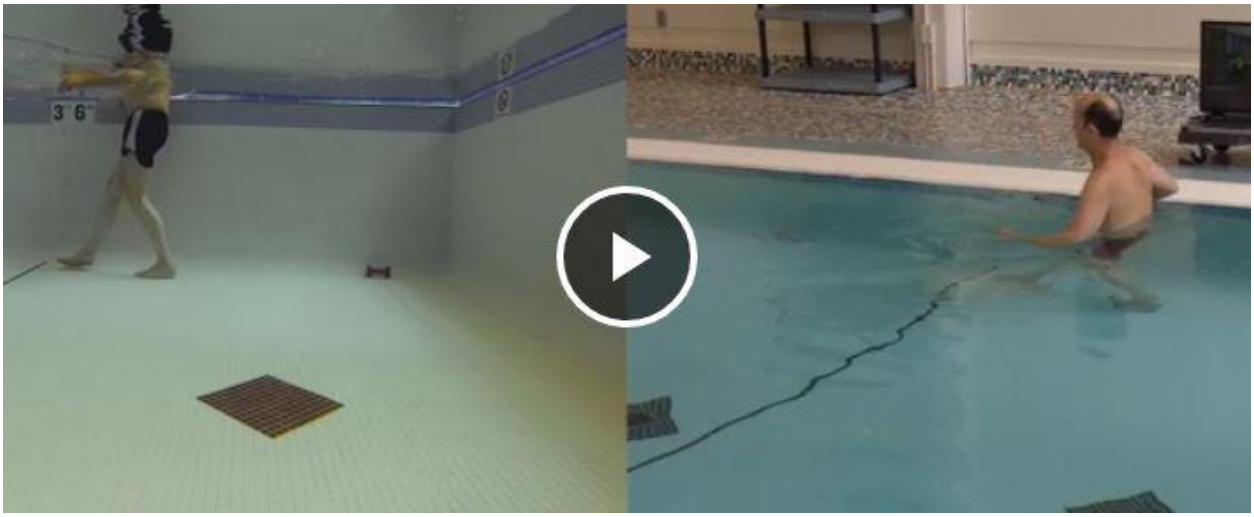

Figure D.15. Walk forward and backward movement along wall.

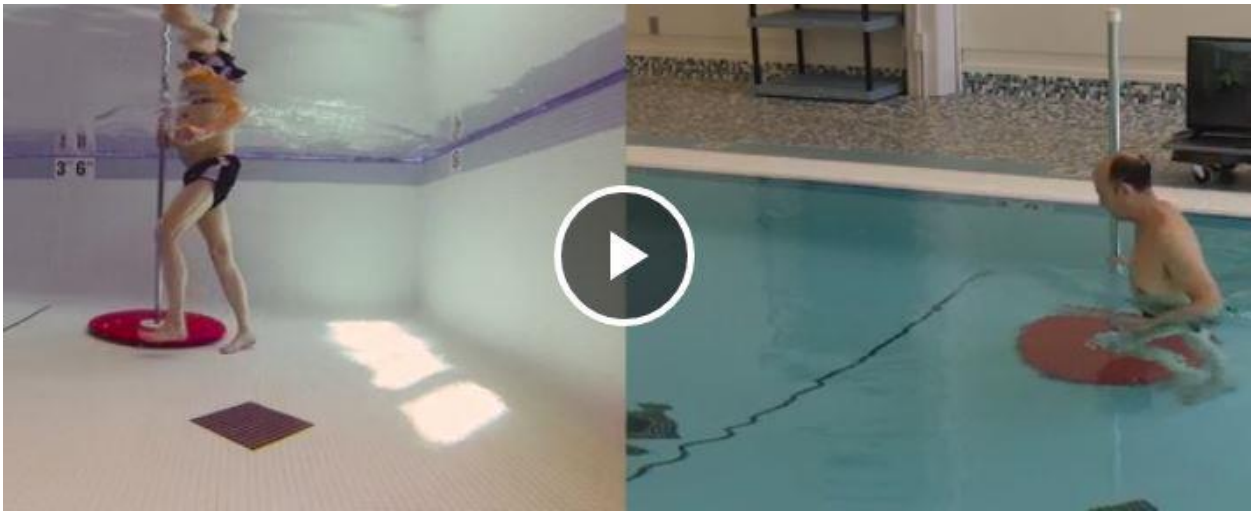

Figure D.16. Walk forward and backward movement with pole.

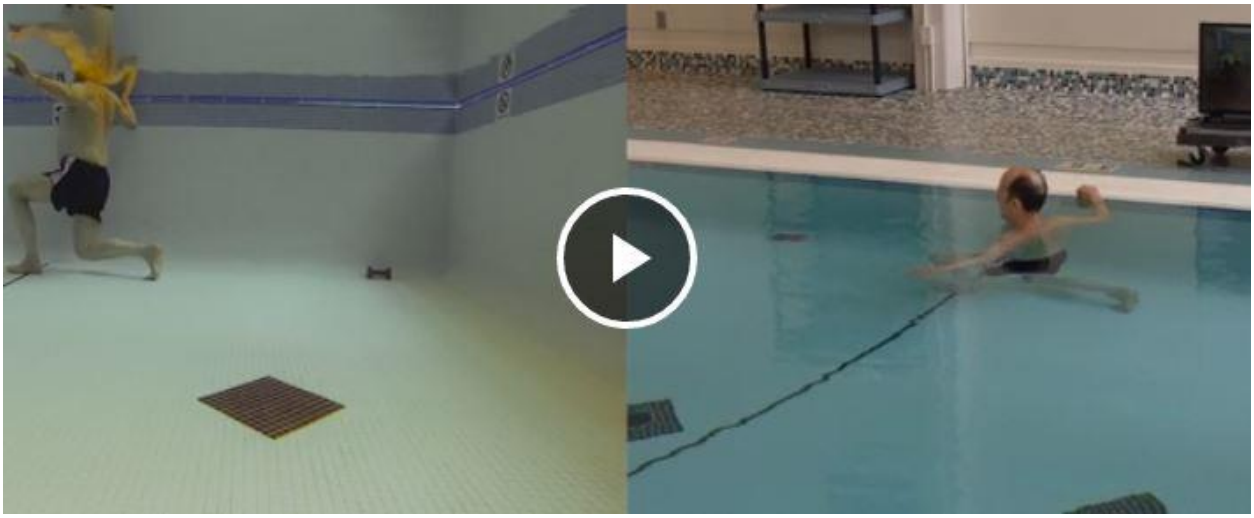

Figure D.17. Lunge movement at wall.

Figure D.18. Lunge movement with pole.

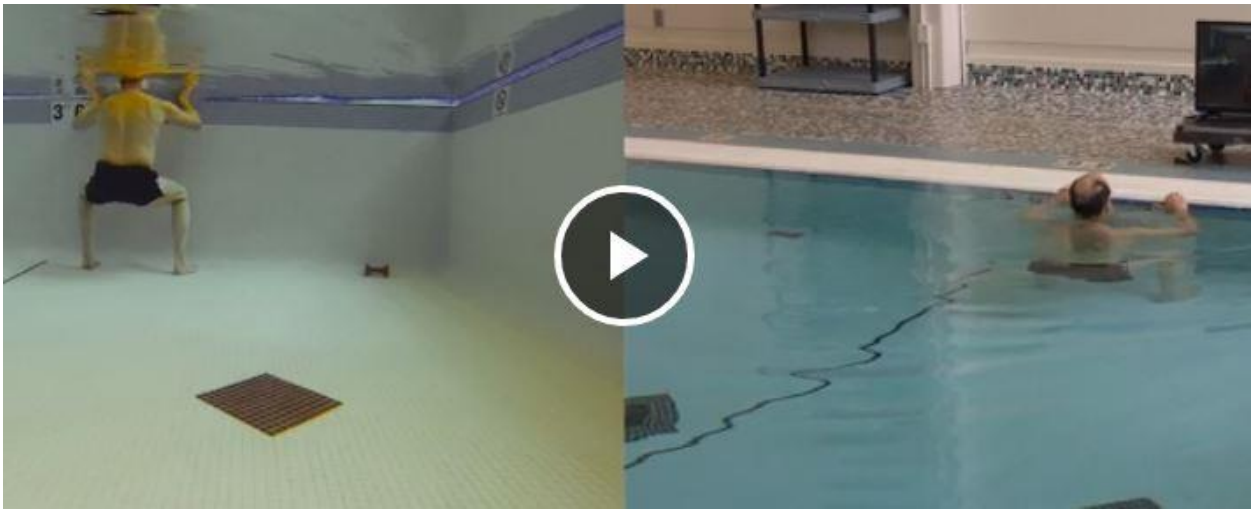

Figure D.19. Squats with side-steps movement along wall.

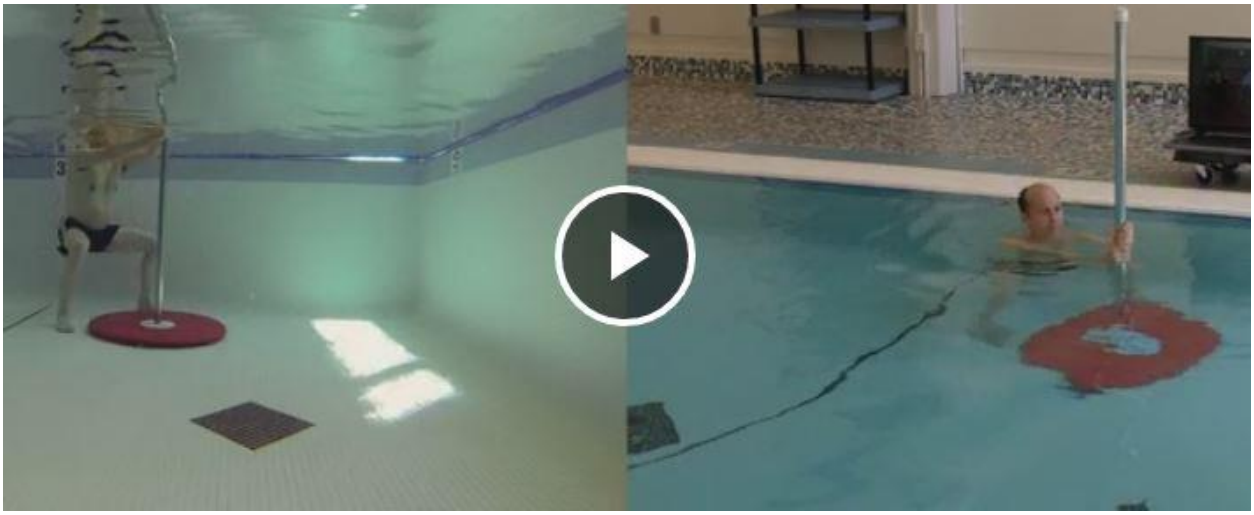

Figure D.20. Squats with side-steps movement with pole.

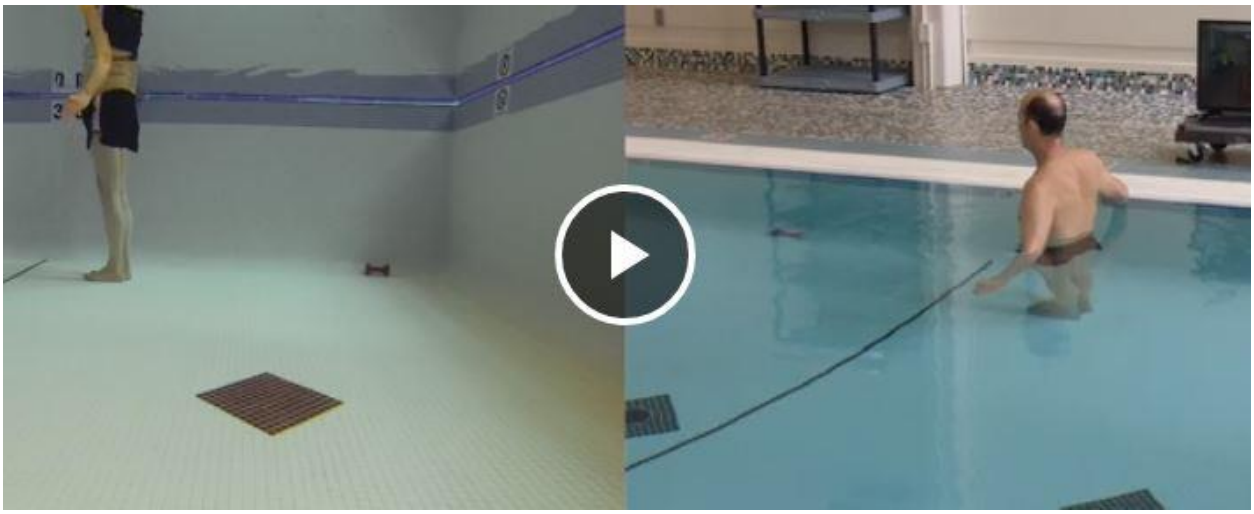

Figure D.21. Posterior deltoids, latissimi dorsi, and biceps movement at wall.

Figure D.22. Posterior deltoids, latissimi dorsi, and biceps movement with pole.

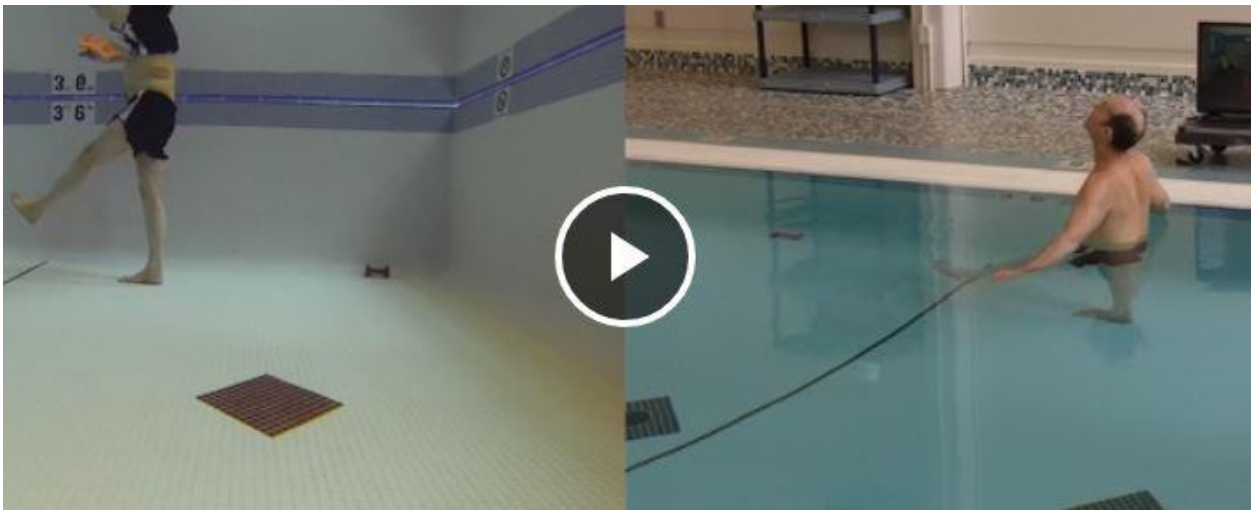

Figure D.23. Hip flexion and extension with lookup movement at wall.

Figure D.24. Hip flexion and extension with lookup movement with pole.

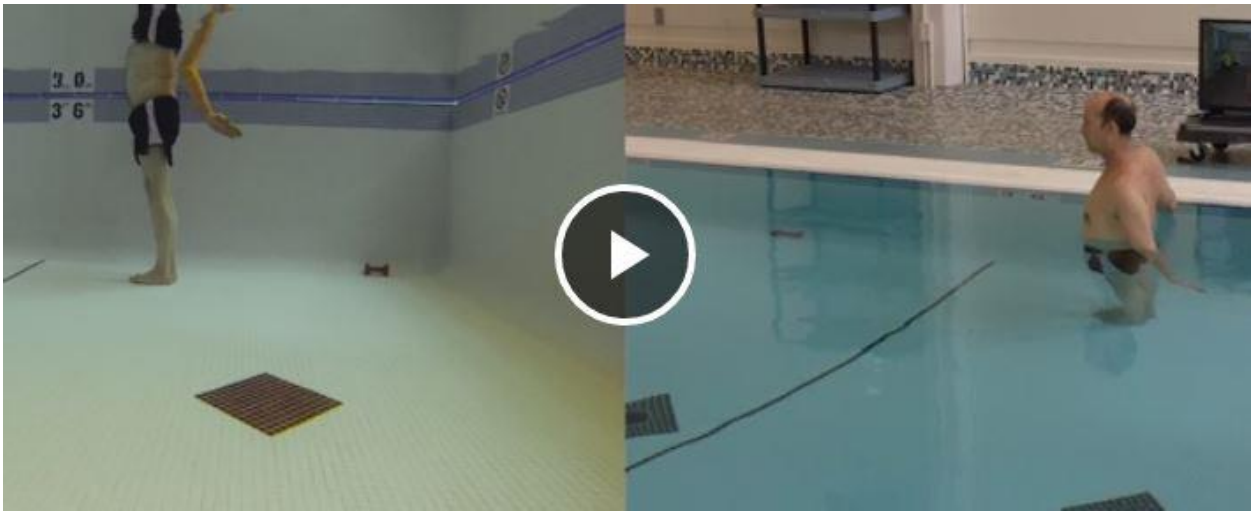

Figure D.25. Rhomboid and trapezius muscle movement at wall.

Figure D.26. Rhomboid and trapezius muscle movement with pole.

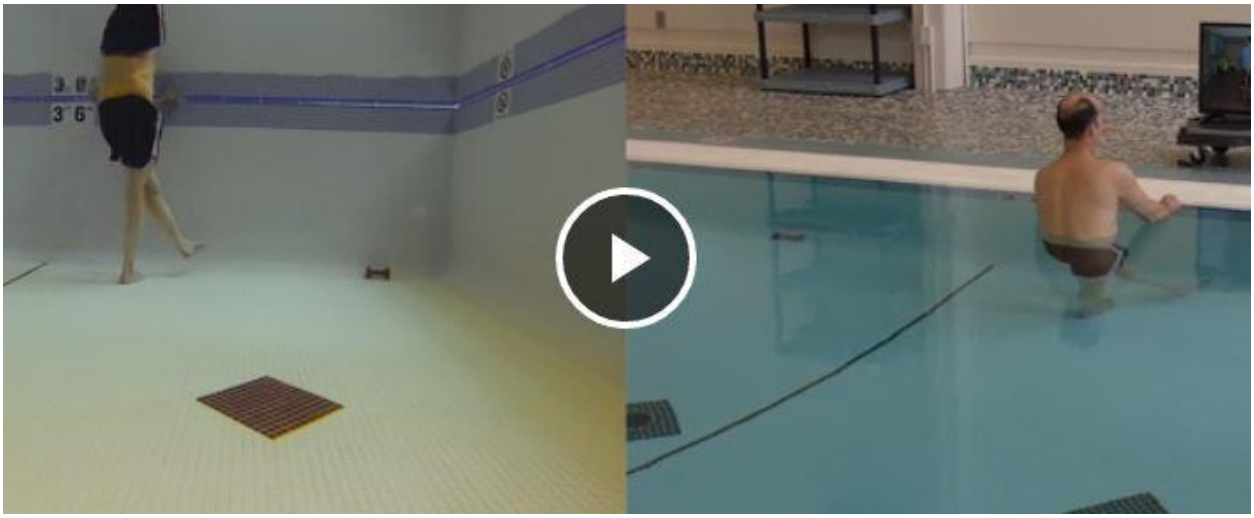

Figure D.27. Hip abduction-adduction crossover movement at wall.

Figure D.28. Hip abduction-adduction crossover movement with pole.

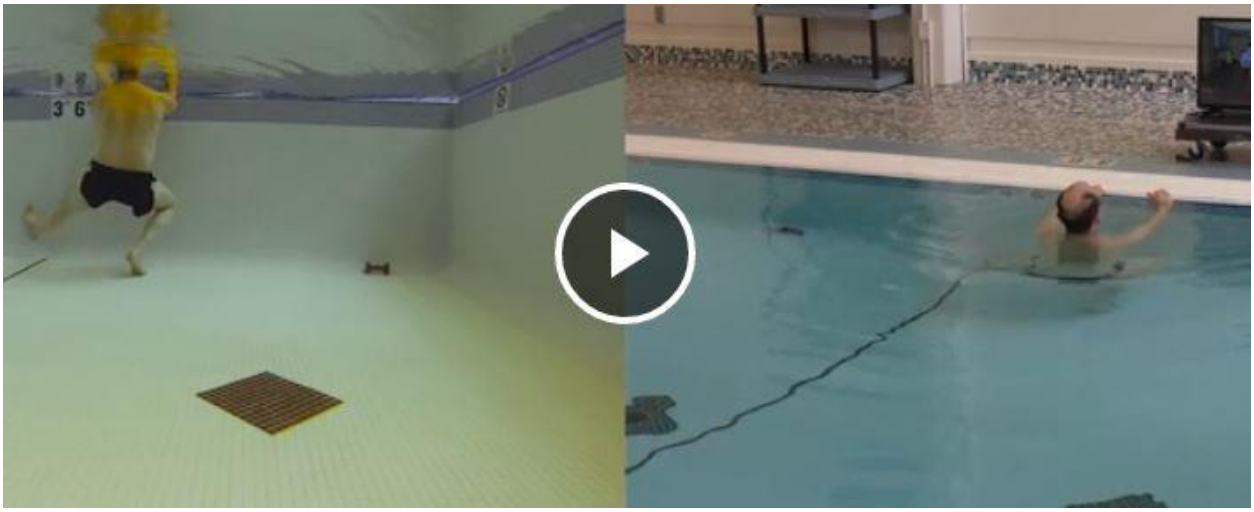

Figure D.29. Squats with alternating leg lift movement at wall.

Figure D.30. Squats with alternating leg lift movement with pole.

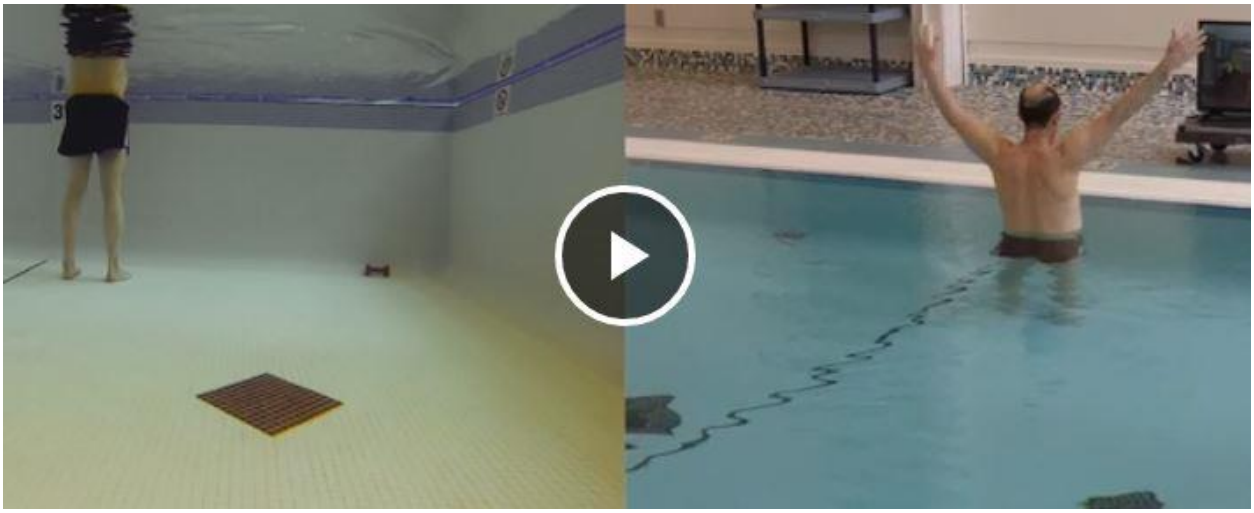

Figure D.31. Relaxation at wall.

Figure D.32. Relaxation with pole.

Appendix F

Curriculum Vitae

Curriculum Vitae

Name: Mark V. Saunders, M. S., Ph.D., Certified Arthritis Aquatics Leader.

Areas of expertise: Aging and human development, fitness/wellness, research on aging well, research on environmental design for active living by aging and aged adults.

Highest degree, major, year awarded, institution: Master of Science, Recreation Administration, Department of Recreation, Park, and Tourism Studies, Indiana University Bloomington, May 2010. GPA: 3.824. Ph.D. Philosophy of Leisure Behavior Department of Recreation, Park, and Tourism Studies, Indiana University Bloomington, October 2017. GPA: 3.889.

Master's Thesis: Effect of card play on perceived life satisfaction and self-esteem of older adults.

Experience: Member of Research Team of Dr. Barbara Hawkins. Projects: (a) Aging Well and (b) DEAL – Designing Environments for Active Living.

Grants and Fellowships

Fellowship: For Academic Excellence, Indiana University, Department of Recreation, Park, and Tourism Studies, Spring semester 2009, $1000.

Fellowship: For Academic Excellence, Indiana University, Department of Recreation, Park, and Tourism Studies, academic year 2009-2010, $2000.

Fellowship: For Academic Excellence, Indiana University, Department of Recreation, Park, and Tourism Studies, academic year 2010-2011, $5000.

LRI Doctoral Research Grant: Leisure Research Institute awarded a research grant for the "Effect of participation in shallow-water movements provided through the use of an aquatic pole on pain and well-being of adult women 61 to 81 with knee and or hip osteoarthritis" doctoral research project, March 24th 2016, $1000.

Awards and Honors

Received the Graduate Option Award for Recreation Management, Department of Recreation, Park, and Tourism Studies, Indiana University Bloomington, April 18th 2009.

Publications

Hawkins, B.A., Miller, T.K., Kim, K.T., (2012). Conceptual and measurement model for ***daily life activity***. *International Journal of Disability and Human Development*.

Co-authored digital learning materials (PowerPoints, test items, and learning activities) for the following chapters in Hawkins, B. A. (2009). *Active living in older adulthood: Principles and practices of activity programs.* State College, PA: Venture Publishing, Inc.
Chapters: 4, 6, 9, 13, 14, and 17.

Teaching

Adjunct lecturer for undergraduate class HPER-R365 Leisure and Aging; Indiana University Health, Physical Education and Recreation Department, Bloomington Indiana. Fall semester 2010 and Spring semester 2011.

Associate instructor for SPH-R512 Administrative Theory and Management Practices in Leisure Services and SPH-R210 Inclusion to Recreation, Parks, and Tourism, fall semester 2015.

Associate Instructor for SPH-R314 Data Based Decision Making, spring semester 2016.

Other

Part-time employee Wildermuth Center, Recreational Sports Indiana University Bloomington; May 2008-April 2010.

Part-time working member; building supervisor, March 1992–May 2013. Monroe County YMCA, Bloomington, IN.

Healthy IU Movement Coach, spring semester 2014.

Worked with interim chair of the Recreation, Park, and Tourism Studies department Dr. Lynn Jamieson. I helped Dr. Jamieson edit and send off two articles to be published: The Relationship of Recreation, Park, and Tourism Studies to Public Health, and Government Policy on Sport and Leisure: A Seven-Country Comparison. June through August 2016.

Invited to give a lecture in Dr. John Hitchcock's topical seminar EDUC – R 685: Single Case Designs: Causal Inference and Understanding Instructional Programs and Systems. I coauthored a presentation with graduate student Matt Hanauer on the use of randomization in the single-case research design. December 2016.

Reviewer for the *Illuminaire Student Journal.* Responsible for reviewing assigned student manuscripts for clarity, development of ideas, scholarly accuracy, overall quality, and compliance with publication guidelines. Also, provide recommendations to the topic editors. Academic year 2016-2017.