THE EFFECTS OF WATER-BASED EXERCISE ON ACTIVITIES OF DAILY LIVING IN PARKINSON'S DISEASE PATIENTS

By

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Abstract

Physical exercise plays an important role in reducing the physical and psychological symptoms of those who suffer from Parkinson's Disease (PD). One form of exercise, water exercise, is a relatively untested means in the treatment of patients suffering from PD. Very few studies have tested the effects of such a program for PD patients. In this pilot study, four patients with PD aged 71-89 years of age followed a six week exercise program in water, three days weekly for a duration from 20 minutes up to one hour in an attempt to improve physical and psychological functions. Testing was done prior to and after the program. The study showed that patients improved on their physical strength, endurance and balance, however tests of perceived self confidence showed no difference between the beginning and end of the study. The results suggest that water exercise is a beneficial medium for PD patients to exercise in and is useful in maintaining and/or improving on strength, endurance and balance. Further research with a randomized controlled trial and a larger sample size is needed to verify the beneficial effects of water exercises for sufferers of PD.

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Chapter 1: Introduction

1.1 Introduction to Parkinson's Disease

With the aging of the population the rise in Parkinson's Disease (PD) is well under way. With more and more health care dollars being allocated to seniors and their health problems, effective treatment of diseases and the maintenance of life quality for seniors are important. Parkinson's Disease is the most common neurodegenerative disease after Alzheimer's Disease (Schapira, 1999). It is a chronic, progressive disorder with no identifiable cause. It is estimated that PD presently affects 1.5 million people in North America. As the population ages, the prediction is that 1% of people over the age of 60, and 2% of people over the age of 70 will be affected with PD (Parkinson Society Canada, 2005). There is no cure for PD. The fundamental defect in PD is a gradual loss of brain cells that produce the chemical dopamine, a neurotransmitter. This results in messages from the substantia nigra to the corpus striatum (the area of the brain that produces smooth, controlled muscle actions for movement and balance) not being delivered or being delivered incorrectly. The symptoms of PD begin to appear when 60% to 80% of the dopamine has been destroyed (National Parkinson Foundation Inc, 2002). Its relation to age could well be due to the fact that both the dopamine concentration and the number of cells in the substantia nigra that produce it fall steadily from birth, some 60% or so having been lost in extreme old age. Clearly, the older the person, the smaller the additional deficit

in cerebral dopamine produced by whatever mechanism that is required to produce parkinsonian symptoms (Caird, 1991).

Most people with PD find that they have had the disease for several years before the initial diagnosis. This is understandable because many of the early symptoms of PD are also the signs of aging experienced by everyone. Parkinson's Disease exacerbates the normal aging process. It affects each person differently. In some it progresses quickly, while in others the progression is quite slow. Some people become severely disabled over time, while others experience only minor movement problems. Often, seniors who suffer from PD will degenerate over time until a point is reached where they can no longer take care of themselves or where home care is no longer sufficient and they need to be institutionalized. This places extra cost pressures on the health care system (Lesemann, 1993). Lesemann claims that if people remain well enough to be able to be cared for in their own homes, the resulting savings can be up to 75% of the costs of equivalent care in a hospital setting. Long term care institutions, such as nursing homes, are more cost effective than hospital care, the per diem cost being two to three times less (CIHI, 2001). But home care is the most cost effective way to support people that can no longer function independently, and the 2003 Health Care Renewal Accord recognized home care as one of the priority areas to receive substantial funding (Health Canada, 2003).

Additionally, PD carries many secondary symptoms that may affect people, and it may pass unnoticed for several years which increases the probability of later diagnosis. Diagnosis is made if two or more cardinal signs are present. The cardinal signs include resting tremor (shaking – affects approximately 75% of all sufferers and

is usually more evident on one side of the body), postural instability (impaired balance and muscle weakness), muscle rigidity (stiffness of the limbs and trunk) and bradykinesia (slowness in initiating movement and changes in the speed and size of movement). Muscle rigidity and bradykinesia affect almost all sufferers of PD. There are also many common secondary signs such as freezing or having dyskinesis (involuntary movements) associated with anti-parkinsonian medications (Stanley, Protas, & Jankovic, 1999).

Until the debate about the pathophysiologic cause of impaired movement in parkinsonism is settled, it is difficult to develop a specific exercise treatment for symptoms that include hypokinesia, tremor, and muscular rigidity (Reuter & Engelhardt, 2002). The fact that physical activity increases and maintains a person's health throughout the life span has been well documented. Participation in a regular exercise program is an effective intervention to prevent or reduce functional declines associated with the aging process. Endurance training can help maintain and improve various aspects of cardiovascular function. Strength training helps offset the loss in muscle mass and strength typically associated with normal aging. Regular exercise improves bone health and postural stability, increases flexibility and range of motion (Burke, Holt, Rasmussen, MacKinnon, Vossen & Pelham, 2001). Evidence also suggests that regular exercise provides psychological benefits such as an improvement in mood and subjective well being (Reuter, Engelhardt, Stecker & Baas, 1997). Exercises in water help loosen muscles and decrease trunk stiffness and rigidity. Water's buoyancy improves the body's performance, and water resistance can be used for strength training (WaterArt Fitness Inc, 2003).

There is growing evidence which supports water exercise as a treatment method for many other ailments including stroke, coronary rehabilitation and other neuromuscular disorders such as Alzheimer's or Multiple Sclerosis. This study will attempt to prove that water exercise is also beneficial for PD patients in helping them maintain, and potentially improve, their activities of daily living. There may also be other benefits such as improved mood and psychological well being. Patients with PD should particularly benefit from water exercise therapy as the multidirectional hydrostatic pressure of the water on the body virtually eliminates falls, to which Parkinson's patients are prone. Only a limited number of studies have reviewed the effect of water exercise therapy on patients with PD. The proposed study will investigate further the benefits of water exercise therapy for Parkinson's patients, using quantitative and qualitative methodology. Many people with PD do not exercise because of the fear of falling. If this study shows that rehabilitation through water exercise is achievable, it will provide a means for PD patients to maintain their mobility as they can exercise without the fear of falling. Their increased mobility will enable them to remain independent for a longer period of time, and costs to the health care system will be reduced.

1.2 Literature Review

The symptoms of PD can be relieved through a regular exercise program targeted to increasing strength, flexibility, endurance, balance and mobility by using simple functional movements. There is considerable literature showing that physical

exercise of moderate intensity leads to an increase in the level of dopamine, which suggests that an exercise program for PD patients would be beneficial (Baatile, Langbein, Weaver, Maloney & Jost, 2000). There have been many studies involving humans and animals documenting the importance of exercise for patients with PD. However, most of these studies have occurred on land rather than in water.

A clinical trial conducted at the School of Physical and Occupational Therapy at McGill University confirms the value of therapy in maintaining functional independence and in improving physical and motor symptoms for persons with PD. The research results showed that the subjects of the treated experimental group maintained their functional status after one year, demonstrating a significant decrease of bradykinesia. They also perceived a significant improvement in their psychological well-being (Gauthier, Dalziel & Gauthier, 1987).

Various other studies have obtained similar results with improvements to various degrees in mobility, dexterity and flexibility (Schenkman, Morey & Kuchibhatla, 2000). There have been studies with PD patients and improving gait (Protas, Mitchell, Williams, Qureshy, Caroline & Lai, 2005; Hausdorff, Nelson, Kaliton, Layne, Bernstein, Nuernberger, et al. 2001). The ability to generate a normal stepping pattern is not lost in PD. Normal stride length can be elicited in PD using attentional strategies and visual cues, possibly because both these methods focus attention on the criterion of stride size (Morris, Iansek, Matyas, & Summers, 1996). This was further demonstrated in a study by Enzensberger & Fischer (1996), where they found that by using a metronome, subjects with PD were able to lengthen their strides from 50 to 56 cm, reduce the number of steps by nine, and decrease time by

five seconds on a 40-meter walk test. Furthermore, metronome stimulation reduced the number of freezing episodes (Enzensberger & Fischer, 1996). These studies show a large increase in functionality though improvement of gait patterns.

Research done by Schenkman, Cutson, Kuchibhatla, Chandler, Pieper, & Ray, et al. (1998) studied an exercise program based on the concept that muscle length and improved coordination can be achieved when people are taught to move in a relaxed manner, with the participation of appropriate muscle groups only. This standardized program includes a series of exercises divided into seven graduated steps. The exercises begin in the supine position and progress to standing. The exercises learned in each stage are continued throughout the program with progressively higher-level activities added. Schenkman, et al. (1998) found baseline range of motion, spine configuration, and physical performance characteristics of the subjects showed significant improvements. It was suggested from this study that exercise designed to improve spinal flexibility and coordinated movement should also lead to improvements in balance and function, despite rigidity, bradykinesia and motor planning deficits that occur as a direct effect of PD. Furthermore, Schenkman, et al. (1998) state that movement through relaxation, rather than specific stretching and strengthening, was incorporated into the program to counteract the effects of rigidity on axial motion and posture. Additionally, the exercises were designed to assist participants in overcoming the motor planning difficulties experienced by people with PD. Typically, people with PD revert to more primitive movement patterns lacking many of the autonomic postural adjustments and spinal movements that accompany simple activities, such as turning over in bed or getting up from a sitting position.

Additional functional results of this study are the subjective comments from the participants to the physical therapists, which were recorded during treatment. Comments included: "Now I'm able to turn over in bed myself;" "It's easier to stand up from a chair;" "I feel more stable on my feet;" and "I can scratch my back now."

Palmer, Mortiner, Webster, Bistevins, & Dickman (1986) found improvements of general motor disability in people with PD through exercise therapy. This was a two-program study of slow stretching exercises recommended by the United Parkinson Foundation, and upper-body karate training. Patients in both groups of the Palmer, et al. (1986) study showed improvement in gait, arm tremor, grip strength and motor coordination tasks involving fine control after only three months of exercise therapy. This shows that a variety of modalities can be utilized in the enhancement of functionality of individuals with PD.

The findings of Palmer, et al. (1986) were confirmed in a study by Reuter, Engelhardt, Stecker, & Baas (1999). They found significant improvement in PD-specific motor disability as a result of a 14-week exercise program consisting of various standardized sports activities that were performed twice weekly for one hour.

A pilot study to test the theory that exercise may slow the onset of PD was started in 2004. Dr. Michael Zigmond (2004), co-director of the Center for Neurosciences at the University of Pittsburgh School of Medicine announced that studies were taking place to identify individuals with PD, put them on an exercise regime and see if it is preventive. They conducted a study with rats which showed that animals that exercised a limb lost significantly fewer brain cells that contained dopamine than those rats that did not exercise. Dr. Zigmond says that several small pilot studies are

under way involving patients diagnosed with PD. This represents a new direction for PD research.

Physicians tend to underestimate the importance of exercise for combating PD. Their first line of defense is often drug therapy, and not often is exercise added to that regimen. However, chronic use of drugs may cause more motor complications in those with PD (Danisi, 2002). Formisano, Pratesi, Modarelli, Bonifati, & Meco (1992) found that in a comparison between patients with PD treated using drug therapy only and patients treated with drug therapy and exercise, there was a significantly lower level of disability in the latter group.

However, there is conflicting evidence. Pedersen, Oberg, Insulander, & Vretman (1990) reported a deterioration of stride length and gait velocity after physical therapy in ten PD patients. Despite participants' reported subjective impressions that the training was beneficial, there was no statistically significant improvement in the motor tasks. These results suggest that increased well-being contributes to the benefits of exercise therapy but is not the only decisive parameter. It is not obvious why this study's results disagree, because the training program did not differ from those of more successful group studies.

Gibberd, Page, Spencer, Kinnear & Hawksworth (1981) reported no benefit of physical therapy compared with occupational therapy in 24 patients with stable PD who participated in a four-week therapy program of two sessions per week and crossed over after a three-month gap. The authors did not find a significant difference between the two treatments and concluded that physical therapy does not improve the

physical condition of stable PD patients. The short duration of the program may have been insufficient to show improvement in an elderly population.

One reason these discrepancies may occur may be the rating scales that were used in the studies. For instance, the PD rating scales are not designed to measure improvements from a physical program. Most measure specific musculoskeletal impairments and are not sensitive for short-term PD alterations. The Hoehn and Yahr scale (Hoehn and Yahr, 1967) is too large to measure subtle changes. Also, the various scales (UPDRS, CURS, Hoehn and Yahr stage) measure different aspects of PD and it is difficult to compare patients who have been rated by different scales (Reuter & Engelhardt, 2002).

The majority of studies were done using land-based exercise regimes, only one study included exercises in water. Water has rarely been tested as an exercise medium, especially for people with PD. Very few studies have been documented. One study showed that hydrotherapy produced greater benefits for people with rheumatoid arthritis than exercising on land and a progressive relaxation program (Hall, Skevington, Maddison & Chapman, 1996). So why would water be a good medium for PD patients to exercise in? Proponents of water exercise claim that one of the best places for training posture and balance is in the water. Water offers freedom from canes, walkers and wheelchairs as these assistive devices are replaced by a three-dimensional support medium surrounding the body. Postural improvement is achieved as the body is stabilized in a vertical position without the need for something to lean or sit on. The buoyancy of the water allows participants to practice good posture and gait mechanics without the fear of falling, which is a common

problem with PD, and the currents generated by movement in the water provide a constant challenge to balance. Gait and balance problems are the most disabling symptoms of PD. If the claims by water exercise proponents are true, being able to work on these impairments on a regular basis would help to maintain functionality and retard the progression of the disease. Walking through water is supposed to strengthen and lengthen muscles with every stride because the resistance of water optimizes strength training. The water also provides a constant massage that would help to combat muscle rigidity.

WaterArt Fitness International Inc. is a company that specializes in rehabilitation for neuromuscular, joint and other physical disorders. For their water rehabilitation programs they have devised specific exercises as well as exercise equipment. For instance, stepping exercises using spaced out exercise steps to step onto or over is aided by buoyancy in the water and can give a feeling of tremendous accomplishment to someone who would normally use a walker on land. The buoyancy of water assists every upward movement, making movements that are difficult on land, easier. The steps can also be used to practice directional change by placing the steps at different angles. Using aquatic mitts while exercising provides a larger area for the hands and upper body. A bonus when using mitts is that they keep the fingers separated from the thumb thus preventing the pill-rolling tremor movement associated with Parkinson's Disease. WaterArt Fitness International Inc. (2003) claims that rocking exercises can be introduced that will not only train for muscle balance but are also used as a training tool to break the "freezing" cycle that occurs frequently on land in

PD patients. The list of water exercises is numerous and allows each person to progress at his/her own pace. The best part about aquatic exercise is that a water-massage is given throughout the program. This allows the muscles to relax and ease tension in the body while increasing muscle tone. Apparently most participants leave the water with a renewed sense of well-being.

In order to verify their impressions of the effectiveness of water exercise, WaterArt Fitness International Inc. conducted a research project with the Parkinson's Association of SW Florida under the direction of Marjorie Johnson. The study had 11 participants, aged 63 to 88 years in various stages of PD, who participated in water exercise three times per week for a period of one hour. Prior to the beginning of the program, each of the participants was tested for upper and lower body strength, upper and lower body flexibility, static and dynamic balance and mobility. During the 12 weeks, they performed moves that targeted walking, flexibility, balance, gait mechanics, as well as upper and lower body strength training. Various pieces of equipment were used including webbed gloves, Speedo aquatic steps, paddles and noodles to add variety to the exercise inventory and to keep the program interesting. At the end of the 12 weeks each participant was retested. Four of the 11 participants improved in all eight areas tested, three improved in seven of eight areas, two improved in five of eight areas and two improved in four of eight areas tested. In short, all of the participants experienced improved levels of functionality through a water exercise program targeted to their needs. Many of the participants also indicated additional benefits such as medication reduction, reduced muscle rigidity,

fewer aches and pains, reduced fear of navigating in crowded situations, and lessening of depression. Because of their success with the water exercise program, the participants are continuing with water exercise, and the program has been expanded to be able to accommodate more participants. In addition, the National Parkinson's Foundation has sponsored the production of an educational video of the water exercise program.

Summary table of relevant studies on the efficacy of exercise programs for older adults with Parkinson's Disease.

Reference	Patient Selection	Training Design	Measurement	Results	Comments
Gauthier et al, 1987	-All participants had idiopathic PD -Unclear how many participants were in the study	-Group rehabilitation for 6 months -Occupational therapy exercises	-Compared pre- and post treatment evaluation after 6 month of occupational therapy	-Maintained functional status after one year -Decrease in bradykinesia -Improved psychological well being	-Randomized controlled trial
Reuter et al, 1999	-16 participants without cardio-vascular diseases -Exclusion of PD patients unable to walk or stand without help	- Standardized sport activities -Exercised 2x/ week for 1 hour -Once/week in water, once per week in gym, for 14 weeks	-UPDRS [1] - CURS [2] -BMT [3] - MMS [4] - SIP [5] - AMQZ [6]	-Physical and mental imp.[9] -MMS [4]: no change -Imp.[9] evident 6 wks after trial ended	-Open trial
Schenkman et al, 1998	-46 participants -34 men and 12 women -Between ages 55-84 years -Stages 2 or higher on the Hoehn-Yahr	-2 groups, 1 doing individual physical exercise 3x/week (45 min. to 1 hr) for 10 weeks -One control group no intervention	-Functional axial rotation -Functional reach -Timed supine to stand	-Significant imp.[9] in axial rotation and functional reach -Not significant in supine to sit time	-Randomized controlled trial

Baatile et al, 2000	-6 male participants -Mean age = 72.7+/- 3.7 years -3 subjects– stage 2 -1 subject–stage 2.5 -2 subjects– stage 3	-Pole striding for 8 weeks -Up to one hour/3 times weekly	-UPDRS [1] -PDQ-39 [7]	-all subjects improved mobility and ADL's [8]; 3 had lower cognition & well-being	-Small sample size (n=6) -Subjects served as own control
Schenkman et al, 2000	-251 community adults with PD -Of those, 56 diagnosed with PD, 195 had no impairment	-2 groups, one placebo and one exercise group	-Measured spinal flexibility, axial rotation, configuration and functional limitations	-Significant associations between functional reach and spinal flexibility	-Randomized controlled trial
Protas et al, 2005	-18 male participants -All were rated stage 2 or 3 on the Hoehn-Yahr scale	-Trained group and placebo group -Step training for 1 hour a day, 3x a week, for 8 weeks	-Gait speed -Cadence -Step length	- Reduction in falls in the trained group -Gait speed and stride length increased for trained group	-Randomized controlled trial
Hausdorff et al, 2001	-67 men and woman aged 70+ -All had functional impairments -Not engaged in physical activity program	-30 in exercise group and 37 in control group -Exercise group were give a 6 months home-based exercise program -Focused on strength, balance and mobility	-Gait -Quality of life -Depression -Balance -Flexibility -Strength -Endurance -Univariate and multivariate regression analyses	- Imp.[9] in physiological capacity is associated with reduced gait instability - Reduced gait instability - Decreased stride time - Increased strength	-Randomized controlled trial

Palmer et al, 1996	-All participants had PD -Unclear how many participants were in the study	-3 month exercise program -2 different programs, one using slow stretching exercise and the other upper body karate exercises	-Measured by machine measurements of grip strength, motor coordination and speed	-Both groups showed imp.[9] in gait patterns, improved grip strength, and improved motor co-ordination	-Randomized Controlled trial
Formisano et al, 1992	-All participants had PD -Unclear how many participants were in the study	- Two groups - One drug therapy group and the other a drug therapy with exercise group - 4 months of physical therapy exercise -Passive and active mobilization exercises	-Clinical rating scales and motor performance tests	-Exercise and drug therapy group showed greater imp.[9] than drug therapy group alone -Physical therapy improves functional performance	-Randomized Controlled trial
Pederson et al, 1990	- Ten patients with mild to moderate Parkinson's Disease	- 12-week physical therapy program	- Electromyograph - Gait analysis -Functional level questionnaire	-Deterioration of stride length and gait velocity after physical therapy	-Open trial – small sample size (N =10)
Gibberg et al, 1981	-24 stable PD patients	-2 treatment groups – occupational therapy and physical therapy -4 week therapy programs, 2 sessions per week	-UPDRS[1]	-No difference between the two treatment programs -Concluded that physical therapy has no benefit to PD patients	-Randomized Controlled Trial

WaterArt International Fitness, 2003	-11 participants, aged 63 to 88 years of age -Participants were at various stages on PD	-12 week water exercise program -3 times a week, for one hour	-Upper and lower body strength -Upper and lower body flexibility -Static and dynamic balance - Mobility	-Reduced muscle rigidity -Improved strength -Improved gait -Improved balance -Improved endurance	- Open Trial

[1] Unified Parkinson's Disease Rating Scale
[2] Columbia University Rating Scale
[3] Basic Motor Test
[4] Mini Mental State
[5] Sickness Impact Profile
[6] Adjective Mood Questionnaire of Zeersen
[7] Parkinson's Disease Questionnaire
[8] Activities of Daily Living
[9] Improvements

Chapter 2: Methods

2.1 Study Setting and Selection of Subjects

This study took place at the Scarborough YMCA in the shallow-retractable end of their pool. The depth of the pool water was consistently four feet, which comes to the mid chest of a person of average height. The water temperature was between 87 and 91 degrees Fahrenheit (31 and 33 degrees Celsius) which is fairly warm for water in a pool. This allowed the muscles to be warm in the water and facilitated movements slightly better than in cool water.

Participants were selected using several methods. The first method consisted of a flyer posted in the Scarborough YMCA lobby. If any potential participants were interested, they would contact the program advisor at the YMCA for further information and sign up for the study. A second method included calling doctors' offices, specifically neurologists that deal with PD patients and asking them to refer their patients to the study. A third method was going to nursing homes to inquire about suitable candidates. Other methods included word of mouth and distribution of flyers.

The method of sampling was a non-probability sample. Not every person with PD in the Toronto region had an equal chance of participating in this study. Of the many people affected with PD, only a minute percentage partook in the study. There

were only four participants in the study. As this was a pilot study, the relatively small number of four participants was deemed acceptable for this trial. Of these four, two came from retirement homes. One participant was referred by his doctor and one by a friend. This small sample size does not necessarily accurately describe the population of PD patients. The power of this pilot study will be very small. Regardless of the results of this study, it will not infer that all patients with PD will benefit from exercise. The sample included one racial minority (Philippino), and both male and female participants. The age distribution was from 71 – 89 years of age.

All subjects in the study had to be at stage two or below of the Hoehn andYahr scale and well enough to care for themselves. Use of walkers, canes and wheelchairs was acceptable and did not preclude participation. PD patients that had not exercised lately were given preference for this trial. Half of the participants had exercised previously, but hadn't done so close to the beginning of the study. There was no age restriction.

2.2 Description for Intervention

The first week involved an orientation session and allotment of time slots for the pre-test. The orientation session described the study in detail and showed the lay-out of the facility. At this orientation, participants had the chance to ask questions pertaining to the study or on which they wanted clarification. After all questions were asked and answered, the informed consent form (Appendix A) and the medical

history form (Appendix B) were given out to the participants to complete. Also, participants met all core researchers of the study and had a chance to talk to each of them. Familiarization with the facility was provided through a personalized tour of all equipment, program and change rooms. At their appointed times the participants came to the YMCA for the pre- exercise test. The pre-exercise test consisted of ten different tests measuring balance, cardio-respiratory endurance, muscular fitness and strength (see Appendix D). The testing was done on land in the studio room. This test served as a baseline test to compare with the test results at the end of the trial. The researcher explained what the participant had to do, asked if the participant had understood the requirements, and then stepped away from the participant performing the test so as to not give any non-verbal clues to the participant. No verbal clues were given. Once the physical pre-test was completed by all participants, they were ready to start the water exercise program the following week. All physical tests were derived from the American council of exercise and are used extensively in research involving disease and physical outcomes. The only test that was modified was the stride length and speed test which was changed from a 50 foot walk to a 32 foot walk because of the small size of the gym.

For the next six weeks, the participants exercised in the water. The protocol for the subjects was to wear a bathing suit for the pool. A swim vest was worn by all participants to help movement and preserve warmth in the body. We asked that participants ate lunch prior to exercise and remained on their normal medication

regime. An instruction sheet with general guidelines of things that participants should be aware of was given at the beginning on the study (see Appendix C).

The study intervention was specifically designed for PD patients. This form of water exercise is relatively new. The water exercises were designed by WaterArt Fitness International Inc., a well known company that deals with water rehabilitation for neuromuscular disorders. The study used the exercises outlined in their manual for PD patients. Classes took place three times per week: Monday, Wednesday and Friday from 1 pm to 1:30-1:45 pm. Participants were encouraged to exercise as much as possible. After the six week exercise period, all participants were evaluated on their post physical tests to see if any improvements occurred.

2.3 Data Collection

2.3.1 Hypothesis Testing/Generation

The hypothesis of this study was that water exercise will help alleviate the symptoms of Parkinson's Disease. Of course, this may not occur, but the assumption was that water exercise will have beneficial effects on the symptoms of PD. The hypothesis was generated from previous studies involving exercise and other joint or neuromuscular disorders such as arthritis, osteoarthritis and multiple sclerosis.

2.3.2 Measurements and Statistical Methods

The collection of data used to evaluate the study was made at the end of the six week program. Several methods were used.

One method was a physical test that measured physical characteristics of participants before and after the six week water exercise program. The physical test was comprised of muscular strength, cardio-respiratory endurance, balance, mobility and flexibility assessments. Muscular strength was determined based on the number of repetitions completed during a bicep curl and sit to stand test, assessing both lower and upper body strength. The balance tests were comprised of a static and dynamic component. Cardio-respiratory endurance was measured using a two minute step in place test. Mobility was measured using an eight foot get up and go test and a stride/speed walk test, and flexibility was assessed by a chair sit and reach test and a back scratch test. Descriptions of all tests can be found in Appendix G. Comparing results before and after showed if improvements occurred after the exercise program.

Another method was the completion of two survey forms: an ABC Scale (The Activities-Specific Balance Confidence Scale) which looks at the level of self confidence at the time of completion (see Appendix E), and the Vitality Plus Scale (see Appendix F) that looks at how the participant is currently feeling. Both surveys were given at the beginning of the trial and at the end of the trial, and were then compared using a paired t-test to see if any subjective improvements took place.

A third method was the conducting of a focus group at the end of the study. The focus group was conducted by an independent researcher who was not familiar with the study, to eliminate the possibility of bias. The participants' comments thus collected allowed the researcher to assess the feelings and thoughts of the participants about the study (Appendix H).

Also, observations were made through participant observation. A journal log of all water exercise classes was kept. This allowed the researcher to make daily notes of all participants, the exercises done and their feelings at the time.

The quantitative analysis consisted of a paired T-test to compare the physical improvements from the beginning to the end of the study. Test scores taken by the researcher at the beginning of the program were compared to test scores taken by the researcher at the end of the exercise program. Essentially, the T-test compares the means of scores for the same people on two testings. However, with the limited data set, the chance of finding any significance with such a small sample size is very slim.

Another test that was used was the Pearson Product Correlation to determine if any correlation could be found between the participants' subjective views on their progress and their actual physical results from the water exercise study. This test will also compare the subjective findings from the confidence scales and compare them to the physical findings of the trial.

Chapter 3: Results

3.1 Characteristics of the Study Sample

The initial response rate to our recruiting efforts was low. Over time, more people expressed interest, but unfortunately by that time the study had already begun and those people could not be accepted. Six people started the study but two dropped out. One drop out was due to anxiety in the water, and the other due to a change in medication. All four participants had PD. Out of the four participants, two were male and two were female. All were classified as stage two on the Hoehn and Yahr scale. The age range of the participants was 71 to 89. All data about length of time in the water, temperature of the water, and the overall participation in the study was recorded. The data is summarized in Table 1.

Table 1. Subject profile and training record for the four subjects with Parkinson's Disease that completed the six week water exercise therapy program.

Subject	Body Mass Index	Hoehn & Yahr Classification	Exercise Time (min)			Training Sessions Attended (%)
			Average	Minimum	Maximum	
1	24.5	2	41.5+/- 6	30	50	94
2	23.2	2	41.3+/- 9.5	20	55	88
3	19	2	41.2 +/- 7.6	25	50	100
4	30	2	29.2 +/- 7.9	15	40	76
Mean	24.2		38.3 +/- 7.8	22.5+/- 6.5	48.8 +/- 6.3	89.5 +/- 10.2

3.2 Qualitative Results

The focus group session provided excellent subjective feedback about the participants' opinions of the water exercise program and their thoughts about the other participants. All participants within the study claimed that they improved, specifically that their walking speed and endurance increased during the course of the study in addition to their balance being better. Also, a couple of participants said that their strength improved dramatically from the beginning of the study. All participants, while expressing their thoughts about the other participants in the study, had only positive things to say about each other and the improvements they had seen in each of them.

When asked if their confidence in doing daily activities has improved, three of the four participants claimed that they were more confident. They felt more confident because they felt better, and they felt as though they had improved. Daily tasks were easier to perform and they were not as tired as before. The one participant who said "no" to having more confidence said that although she had increased ability to perform chores, she had always been confident in her ability to do chores.

All participants enjoyed the water exercise program. They enjoyed the exercises in warm water and the chance to swim, something they don't have much opportunity to do. One participant overcame her fear of the water and is eager to pursue

exercising in the water in the future. All said that exercising in the water was much better than exercising on land.

Although increased confidence in doing activities of daily living after the water exercise therapy program was expressed in the focus discussion session by three out of the four participants, the paired t-test did not show that there were any significant differences between confidence scores on the ABC Confidence Test. Even though the ABC scale showed no difference, participants three and four did improve on their self confidence and abilities to perform activities (see figure 1). Also, three of the four participants did improve on their vitality plus rating scale score despite the paired t-test showing so significant difference (see figure 2).

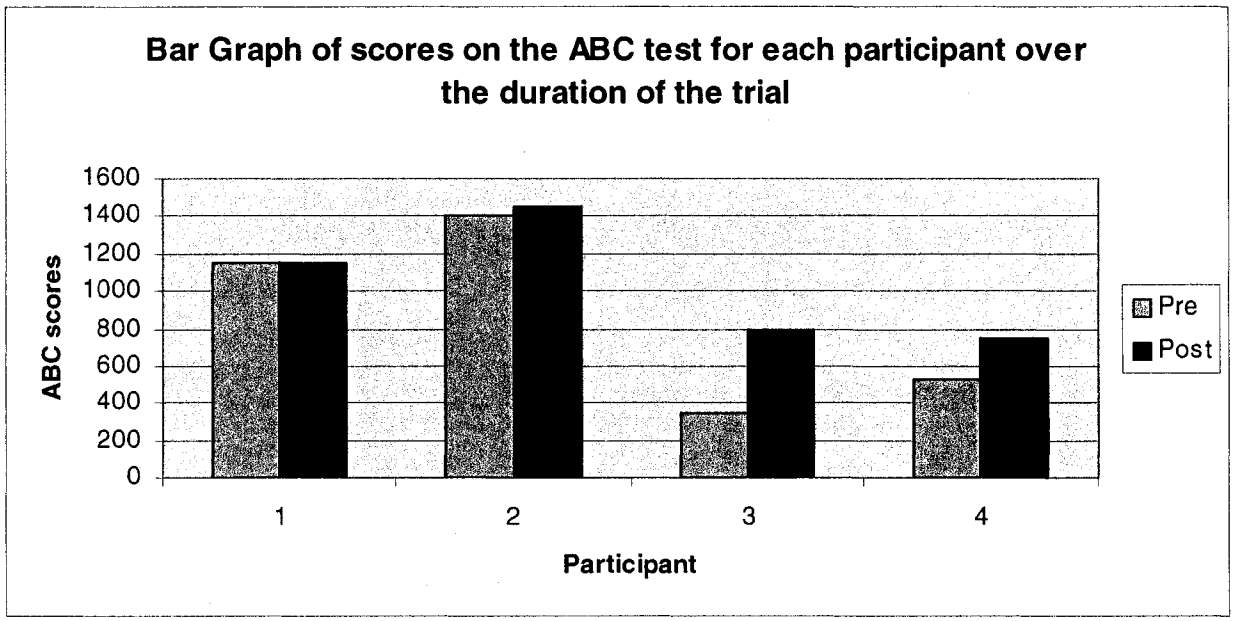

Figure 1. Results of the ABC test out of 1600 for all participants on the pre and post test.

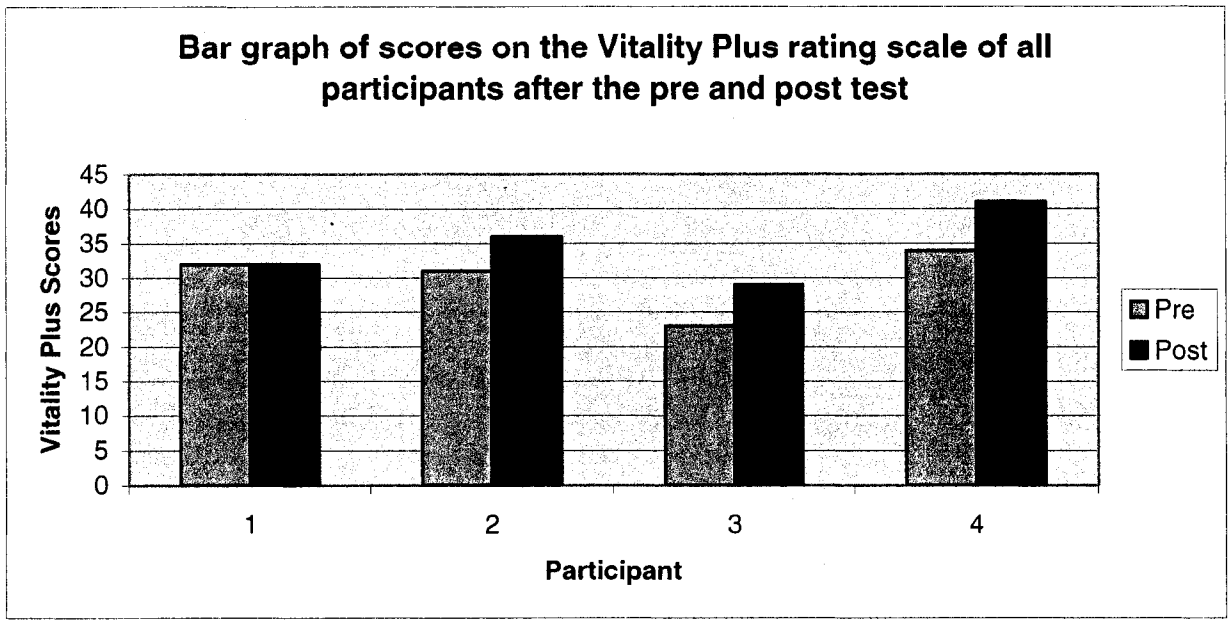

Figure 2. Results of the Vitality Plus ratings scale out of 50 for all participants on the pre and post test.

3.3 Quantitative Results

Participants in the study attended 89.5 +/- 10.2 percent of the scheduled training sessions during the six week period. Strength, endurance, balance, mobility and flexibility all measured by the physical tests showed some significant differences from the baseline results as outlined in Table 2. All physical tests were derived from the American council of exercise and are used extensively in research involving disease and physical outcomes. The only test that was modified was the stride length

and speed test which was changed from a 50 foot walk to a 32 foot walk because of the small size of the gym.

Results from the physical testing scores showed individual improvements on all tests except for flexibility which showed a slight decrease in upper and lower body flexibility in 2 participants. Balance tests showed individual improvement on both the static and dynamic tests of 3 of the participants. One participant was unable to complete both balance tests and any improvement was difficult to measure. All participants individually improved on both strength tests, the bicep curl test and the sit to stand test. Endurance improved dramatically for all participants as all individuals showed great improvements in the 2 minute walk in place test and the get up and go test. All participants improved on stride length, taking fewer steps to walk 32 feet, and the time to complete the 32 foot course improved in 3 of the 4 participants.

A paired T-test was used to determine if there were any significant differences in the pre and post test for all participants. However, with the limited data set, the chance of finding any significance with such a small sample is very slim.

Table 2. Paired T-test comparing results taken from pre-test and post-test of all physical tests.

	Mean	Std. Deviation	95% Confidence Interval of the Difference		T	DF	Sig. (2-tailed)
			Lower	Upper			
Static balance	-3.37500	2.68871	-7.65334	.90334	-2.510	3	.087
Dynamic balance	114.33333	22.72297	57.88635	170.78032	8.715	2	.013
Two minute step in place test	-15.00000	2.44949	-18.89768	-11.10232	-12.247	3	.001
Bicep curl test	-3.25000	3.40343	-8.66562	2.16562	-1.910	3	.152
Sit to stand test	-3.25000	2.21736	-6.77831	.27831	-2.931	3	.061
8 foot get up and go test	9.75000	9.17878	-4.85549	24.35549	2.124	3	.124
Stride length test – 32 feet	3.00000	1.82574	.09484	5.90516	3.286	3	.046
Stride speed test – 32 feet	6.37500	7.76075	-5.97408	18.72408	1.643	3	.199
Chair sit and reach test	-.20000	2.07686	-3.50474	3.10474	-.193	3	.860
Back scratch test	2.32500	4.54120	-4.90106	9.55106	1.024	3	.381

Throughout the study, the majority of the exercises were focused on the lower body. Most of the lower body exercises concentrated on strength, balance and gait. The static balance tests showed no significant difference between the pre- and post test results, however, improvement did occur in all participants. Dynamic balance improved significantly in all participants who were able to complete the tests. One participant was unable to do both the pre- and post test. The two minute steps in place test showed significant differences in all participants, see Figure 3. Each participant was able to increase the amount of steps taken from the beginning of the trial compared to the end of the trial.

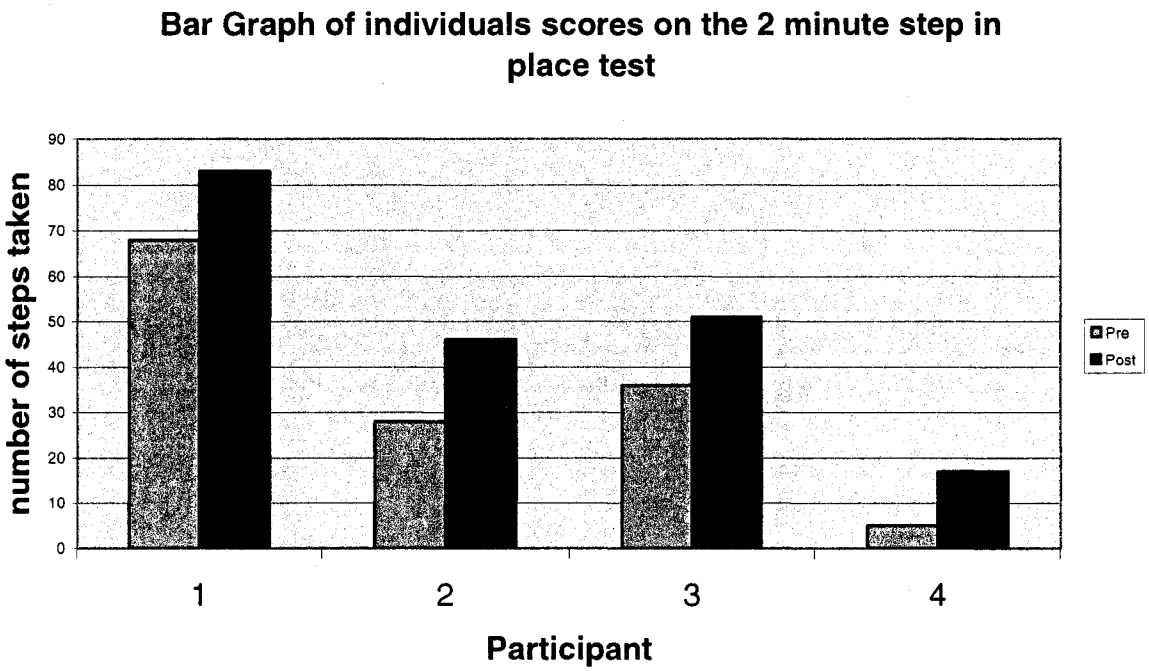

Figure 3. Individual scores of the 2 minute step in place test of both the pre and post test.

The sit to stand test showed no significant differences between the pre- and post testing, however the sig 2-tailed test showed that it was close to being significant ($p=0.061$). All participants improved on their scores from the first testing period. The stride test showed no differences at all, however, the speed in which they completed the stride test showed significant differences. Even though the number of strides taken to complete the test remained relatively the same, the speed in which it was done showed great improvements (see Figure 4.) And lastly, there were no significant differences in the eight foot get up and go test.

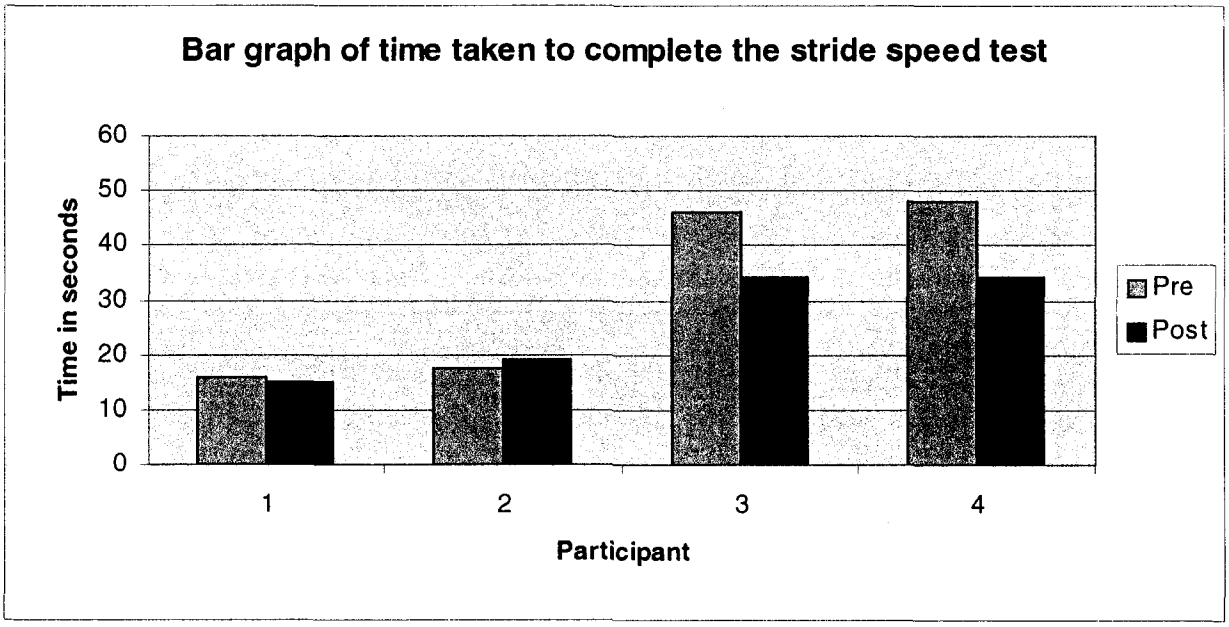

Figure 4. speed in which a 32 meter walk was completed during the pre and post test period of all participants.

The only upper body measure for strength was the bicep curl test. There were no significant changes between the baseline results and the post test results. In three of the four participants, the number of curls that could be done with proper range of movement increased. Upper body exercises during the water exercise program did not begin until mid-way of the second week. And in comparison to lower body exercises, participants only practiced upper body exercises for ten minutes in each session.

Flexibility measurements did not improve during the study. Lower body flexibility was measured by a sit and reach test. In two of the four participants, the scores on the post test were lower than on their pre test. A back scratch test to

measure upper body flexibility found the same results, in this case, three of the four participants had a decreased score from their original test.

On most tests conducted, participants improved to some extent on scores from their baseline test to their post water exercise test. In some cases, individuals showed some improvement while others stayed at the same level as their baseline (see Figure 5).

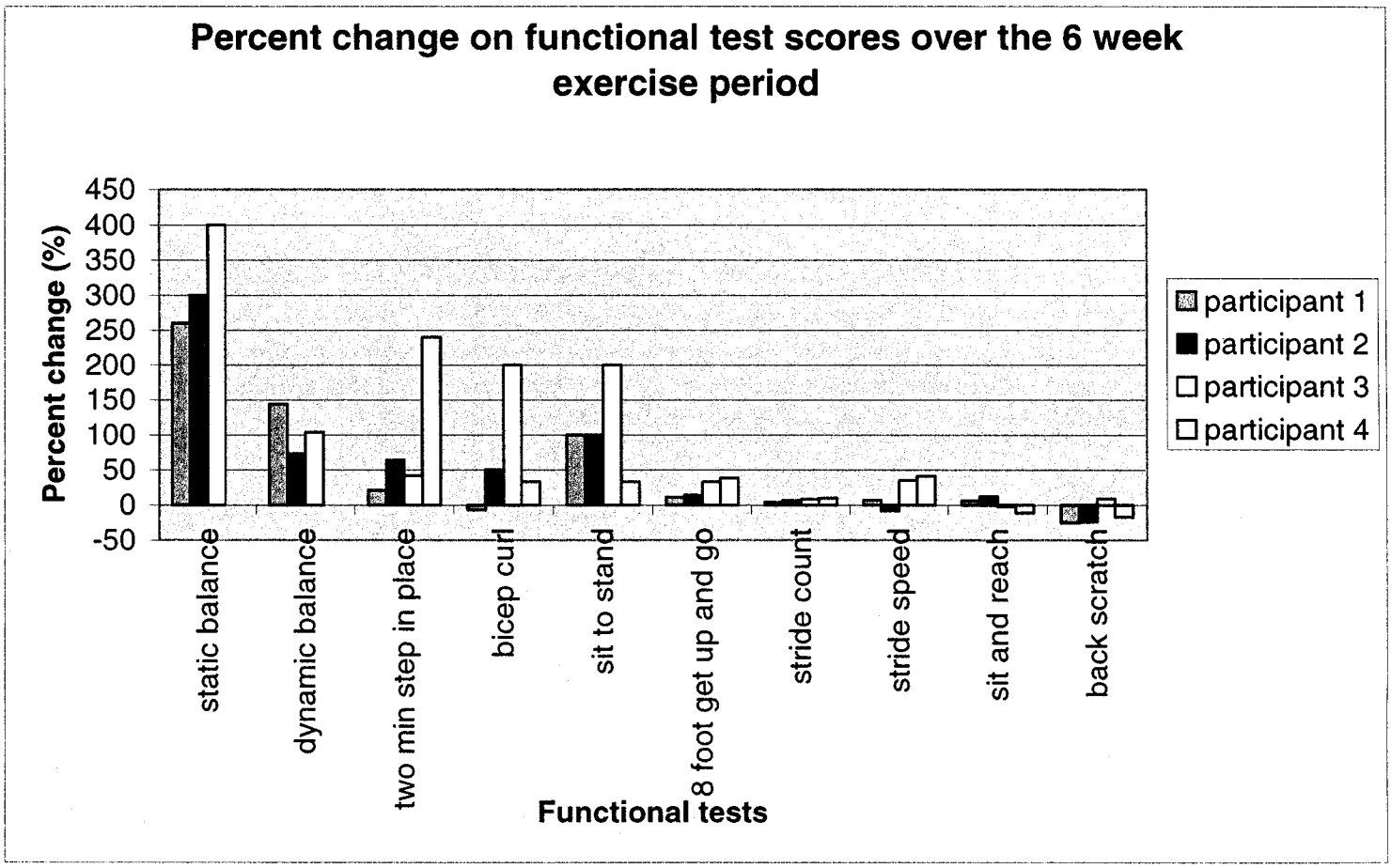

Figure 5. Changes in functional testing scores of all participants from the beginning of the trial to the end of the six week water exercise therapy program.

Chapter 4: Discussion

4.1 Study Strengths and Limitations

This study has provided some results of what an exercise program can do for people with Parkinson's Disease. Despite the fact that only four participants were able to complete the study, all four participants improved on scores and their physical well being. The strength of this study is that it was one of the first in the field for PD. There have been few studies involving water exercises and their effect on PD patients. Even though this study was very small, it was the first study done in Canada. One very important finding of this study is that it shows that improvement achieved after water exercise is not related to age, rather it is based on the severity of the disease. Although all four participants were classified as a two on the Hoehn and Yahr scale, the range of impairment along the two classification is large. The more severe the disease, the tougher it will be for PD patients to exercise. But even at an old age, well into the 80's, PD patients can improve their physical capabilities. This has implications for the treatment of PD, in as much as it points to the need to encourage exercise early on after diagnosis of PD. The participants, regardless of their physical improvement in the study, found it beneficial to be active and out of their homes. This was especially true of the participants living in retirement homes.

There are many limitations to this pilot study. The temperature of the pool varied from 87 degrees Fahrenheit to 91 degrees Fahrenheit. The air temperature outside the water varied, and at times it was cold enough to shiver. The time at which each

participant began the exercise sessions varied somewhat. Also, exercises were not always performed simultaneously as a group for the duration of the exercise session, rather participants would perform different types of exercises during some part of the exercise session. Another factor was that some of the participants needed constant re-assuring that they were doing well and improving over time. They needed constant positive feedback from the researcher, and this could have biased their opinion of themselves and the study. Other limitations are that some of the participants were more active than others. They engaged in activities such as walking or therapy, which prevented them from being sedentary and seeing the true effects of the water exercises.

A major limitation with this study is the small sample size. In doing a paired T-test of 4 participants and with a degrees of freedom of only 3, it has acceptable power to detect very large changes and for measures that are not affected by a range of extraneous variables. This limitation affects both the physical findings and the qualitative findings of the two surveys.

Another limitation of this study is that one cannot indisputably specify that exercise improves the symptoms of PD. The fact that physical improvements occurred is definite from this study. However, many participants had other diseases as well. Three of the four participants suffered from some form of arthritis. One participant suffered from both osteoarthritis and rheumatoid arthritis and all participants suffered from back and knee joint pain. Water exercise can help improve all these problems and has been proven to alleviate pain and increase physical well being in osteoarthritis (Foley, Halbert, Hewitt, Crotty, 2003) and rheumatoid

arthritis (Danneskiold-Samsoe, Lyngberg, Risum & Telling, 1987). It is hard to tell if the water exercises did indeed alleviate the symptoms of PD, or increased the strength and range of motion in the joints of participants with arthritis, although the fact that dynamic balance improved noticeably seems to point to improvement in PD specific impairments.

4.2 Comparison to Other studies

As not many studies have been done involving water exercise therapy and the effects on patients with PD, not much literature or previous studies exist for comparison purposes. The study involving WaterArt Fitness International Inc. shows the positive effects of exercise. The results from this present study support the results found in the WaterArt study. Muscular strength, endurance, gait and balance all improved with this study. Flexibility was the only dimension not to improve from exercise in the water. In general, support for the assumption that water exercise can improve patients with neuromuscular disorders is increasing. Previous studies have outlined the benefits of water exercise on joint disorders, stroke recovery and many other physical impairments.

4.3 Future Implications

With the ageing of the baby-boomers, PD will become more prevalent, as PD is an age related disease. It is important to take into consideration that all forms of neuromuscular disorders can be improved with exercise. Currently most recreational programs are geared towards treating people with arthritis or osteoarthritis. Having programs designed specifically for people with PD will become more urgent. Water exercise programs in particular can help maintain activities of daily living and in many cases, depending on the stage at which an exercise program is started, can produce improvement in physical, endurance and psychological factors. Exercises in warm water is a morale builder because of the soothing feeling generated by warm water. Group exercise facilitates interaction with other people with PD and allows a person to get out of their home. Also, participating in an exercise program and the resulting improved physical functioning may reduce the amount of medication needed by the person with PD. Improved physical functioning may allow the PD sufferer to remain independent for a longer period of time. The last two points would result in considerable savings in health care costs.

Some of the comments made by participants in the current study should be considered in future studies. For instance, it is important that not too many people are in the pool at the same time as the PD patients, as the other people create a lot of water movement which has the potential to knock over a person with PD due to their balance problems. This study held exercise sessions three times a week. Some of the

participants said that exercising three times a week was too intensive, and that twice a week would be preferable. For this study, the exercises took place at 1.00 p.m. The participants living in retirement homes said that this time was inconvenient as it interfered with their set lunch time hour. The timing of medication taking is also of importance for PD patients, as some suffer from dyskinesia as a side effect from taking their medication. This can affect their ability to exercise. However, they all shared again and again how much they enjoyed being in the water, and future studies should incorporate water exercise programs for people with PD. Other general comments made by the participants included the need for more literature to be made available to people diagnosed with PD as far as cause of the disease, drugs, new treatments, etc. are concerned. All participants in the study thought that not enough was being done for those that suffer from PD. They also felt that doctors are not aware enough of the disease.

One hope of this study is that it creates a realization that water exercise programs are indeed needed for people with PD and should be provided. Currently there is not enough awareness of this need. Hopefully, societies like the Parkinson Society of Canada will come to realize the important benefits of water exercises and start to promote such exercise programs. For future research, a randomized controlled trial should be conducted comprising an exercise group and a control group to further verify that water exercise is beneficial for PD patients. More participants are needed with an estimated required sample size of 384 for the exercising group based on a population of 1 million people and the confidence level of 5%. This calculation was

done using the sample size calculator. Various levels of government, from Health Canada to local Parks & Recreation Departments needs to fund and develop specific programs that PD sufferers can access. More funding is needed for research into rehabilitation at universities, and for designing specific exercises for conditions peculiar to PD and for developing best practices. Hopefully this study will serve as a stepping stone for future research into water exercise programs for patients with PD.

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Appendices

Appendix A

Informed Consent Form

1. Explanation of the test and water exercise program

You will be performing a land functional fitness assessment twice during the study. You will be instructed on the assessment objective and then given a practice session to fully comprehend the assessment. The overall objective is for you to go at a pace that is comfortable and safe. We will record the number of repetitions you perform to evaluate your functional fitness level. We will be monitoring your level of comfort throughout the assessment and we may stop the test at any time because of signs of fatigue and discomfort. As a willing participant, you may stop any exercise test should you feel fatigued or any discomfort with the exercise performed.
The water exercise program will be fully explained in detail regarding the type of exercises done. You may stop at any time should you feel uncomfortable with the water exercises.

2. Attendant Risks and Discomforts

There are possible risks involved with this study. During testing and exercise, several changes may occur including abnormal blood pressure, fainting, irregular, fast and slow heartbeat, and in very rare instances, heart attacks, stroke or death. Every effort will be made to minimize these risks by evaluating preliminary scores on functional tests in relation to your health and fitness level. Emergency equipment and staff are available to deal with any unusual situations that may arise.

3. Responsibilities of the Participant

Information that you possess about your health status and/or previous experience with unusual feelings of discomfort with physical exercise may affect the safety and value of your exercise test and water program and is extremely important.
You are responsible for fully disclosing any information when requested by the testing staff.

4. Benefits to be Expected

The results obtained from your functional fitness assessment may assist in the diagnosis of your fitness level and in evaluating what exercises will help improve your health status. All water exercise can only be of benefit to you and should improve your day to day activities.

5. Questions

If you have any questions or concerns about the procedures or tests involved in the study, please ask for further explanations so you may fully comprehend the process.

6. Freedom of Consent

Your permission to perform an exercise test is completely voluntary. You are free to stop the test at any time and or exercise program at any time.

Date_____ Signature of Participant_____

Date_____ Signature of Researcher_____

Appendix B

Medical History Form

Personal Information

First Name:_____ Last Name:_____

Address_____

City_____ Province_____ Postal Code_____

Telephone Number: _____ E-mail_____

Date of Birth Y_____M_____D_____

Gender_____ Height (inches)_____ Weight(lbs)_____

Date of Parkinson's Diagnosis:_____

Symptoms of Parkinson's I encounter:_____
_____

My symptoms are: mild moderate severe

What medications are you currently taking:_____
_____

What times during the day are you taking these medications?_____
_____

Family Physician:_____ Telephone:_____

In case of emergency, please contact:_____

Additional Medical Information	Yes NORMAL		NO ABNORMAL
Cardiovascular/Circulatory			
Do you smoke?	YES		NO
Do you have high blood pressure?	YES		NO
Do you have high cholesterol?	YES		NO
Have you had a heart attack?	YES		NO
Have you had a stroke?	YES		NO
Do you have heart disease?	YES		NO
Do you have a heart murmur?	YES		NO
Do you experience chest pain with exercise?	YES		NO
Do you have an irregular heartbeat or palpitations?	YES		NO
Do you have emphysema?	YES		NO
Do you have asthma?	YES		NO
Other Medical Questions			
Do you have epilepsy?	YES		NO
Do you experience lightheadedness or fainting?	YES		NO
Do you have any other metabolic disorder? (diabetes, thyroid, kidney)	YES		NO
Musculoskeletal	YES		NO
Do you suffer from back pain?	YES		NO
If yes,	Upper	Middle	Lower
Do you have any other joint pain?	YES		NO
Where:_____			
Do you suffer from any form of arthritis?	YES		NO
If yes, what and where:_____			

Physical Activity Information

Have you previously engaged in exercise programs?	YES	NO
Are you doing specific exercises for any disease?	YES	NO
Are you inactive most of the time?	YES	NO
Do you lift weights to increase your strength?	YES	NO
Can you do your own housework and chores?	YES	NO
Do you walk more than 2 miles every day?	YES	NO
Can you walk without a cane or walker?	YES	NO
Do you need to use a wheelchair?	YES	NO
Is it difficult to pull yourself out of bed or out of a chair?	YES	NO
Do your legs feel fatigued after climbing a flight of stairs?	YES	NO
Do you find it difficult to carry a bag of groceries?	YES	NO
Can you reach an item on a shelf above your head?	YES	NO
Is it difficult to bend at the waist?	YES	NO
Do you find it difficult to pick up something from the floor?	YES	NO

Appendix C

Pre Exercise Instructions

Clothing	Wear a swim suit or other non cotton clothing to keep yourself warm in the pool.
Water	Bring plenty of fluids to the exercise class. It's important to keep yourself hydrated at all times. Drink plenty of fluids prior to the exercise class and 24 hours preceding exercise tests.
Drinking/Smoking	Avoid alcoholic beverages and/or smoking prior to the exercise class. Drinking and/or smoking may impair the benefits of the exercise.
Coffee/Tea	Try to avoid any coffee or tea 3 hours prior to exercising. Caffeine will affect your body system and can minimize the benefits of exercise.
Sleep	Try to sleep adequately the night before a class and before the exercise testing. Try to sleep no less than 6 hours and no more than 8 hours.
Physical Activity	Although we encourage physical activity at all times, please do not exercise prior to water therapy, or prior to the exercise testing as it may impair your test results.
Medications	Maintain your regular medication regime. Do not alter your medication schedule due to the exercise program.

Appendix D

Functional Fitness Assessment – Feb 15-17		
NAME:		Date:
Address:		Postal Code:
City:	Province:	
Phone (home):	Phone (work):	
E-mail:		
Physician:		Phone:
Emergency Contact:		Phone:
Date of Birth (mm/dd/year):	Age:	Sex:

Assessment Protocol	
Functional Fitness Assessment	**Results**
Static Balance	
Dynamic Balance	
Two minute Step in place R + L = 1	
Biceps Curl 30 seconds	
Sit to Stand Test	
8 Foot get up and go in seconds around both cones twice	
Stride Count R + L = 1	
Chair Sit and Reach Test Ruler at 20" +or-	
Back Scratch Distance between hands in inches Both sides	

Weight – lbs _____
Height in meters _____
BMI _____

Appendix E

The Activities-specific Balance Confidence (ABC) Scale

For each of the following activities, please indicate your level of self-confidence by choosing a corresponding number from the following rating scale:

0% 25% 50% 75% 100%
No Confidence **Completely Confident**

"How confident are you that you can maintain your balance and remain steady when you....

1. walk around the house? _____%
2. walk up or down stairs?_____%
3. bend over and pick up a slipper from the front of a closet floor? _____%
4. reach for a small can off a shelf at eye level? _____%
5. stand on your tip toes and reach for something above your head? _____%
6. stand on a chair and reach for something?_____%
7. sweep the floor?_____%
8. walk outside the house to a car parked in the driveway?_____%
9. get into or out of a car?_____%
10. walk across a parking lot to the mall?_____%
11. walk up or down a ramp?_____%
12. walk in a crowded mall where people rapidly walk past you?_____%
13. are bumped into by people as you walk through the mall?_____%
14. step onto or off of an escalator while holding onto a railing?_____%
15. step onto or off an escalator while holding onto parcels such that you cannot hold onto the railing?_____%
16. walk outside on icy sidewalks?_____%

The Activities-specific Balance Confidence (ABC) Scale*

Administration

The ABC can be self-administered, via personal or telephone interview. Larger typeset should be used for self-administration, while an enlarged version of the rating scale on an index card will facilitate interviews. Each respondent should be queried concerning their understanding of the instructions, and probed regarding difficulty answering any specific items.

Instructions to Respondents

"For each of the following, please indicate your level of confidence in doing the activity without losing your balance or becoming unsteady by choosing one of the percentage points on the scale from 0% to 100%. If you **do not currently do** the activity in question, try and imagine how confident you would be if you had to do the activity. If you **normally** use a walking aid to do the activity or hold onto someone, rate your confidence as if you were using these supports. If you have any questions about answering any of the items, please ask the administrator."

Instructions for Scoring

Total the ratings (possible range = 0 to 1600) and divide by 16 (or the number of items completed) to get each person's ABC score. If a person qualifies his/her response to items #2, #9, #11, #14, or #15 (different ratings for "up" vs "down" or "onto" vs "off"), solicit separate ratings and use the **lowest** confidence rating of the two (as this will limit the entire activity, e.g, likelihood of using stairs). Total scores can be computed if at least 12 of the items are answered. Note: internal confidence (alpha) does not decrease appreciably with the deletion of item # 16--icy sidewalks--for administration in warmer climates (Myers et al.'98).

Appendix F

The Vitality Plus Scale

This scale looks at how you are **currently feeling**. For each statement, circle a number from 1 to 5 that best describes you. For instance, if you usually fall asleep quickly when you want to circle 5. Otherwise, circle a number from 1 to 4, depending on the extent to which you usually have difficulty falling asleep.

a) Takes long time to fall asleep						Fall asleep quickly
	1	2	3	4	5	
b) Sleeps poorly or restlessly						Sleeps well
	1	2	3	4	5	
c) Tired or drowsy during the day						Feel rested
	1	2	3	4	5	
d) Rarely hungry						Excellent appetite
	1	2	3	4	5	
e) Often constipated						Do not get constipated
	1	2	3	4	5	
f) Often have aches & pains						Have no aches & pains
	1	2	3	4	5	
g) Low energy level						Full of pep and energy
	1	2	3	4	5	
h) Often stiff in the morning						Not stiff in the morning
	1	2	3	4	5	

i) Often restless or agitated Feel relaxed

1 2 3 4 5

j) Often do not feel good Feel good

1 2 3 4 5

Administering the Vitality Plus Scale (VPS)

Remove the scale title prior to administration. The VPS can be either self-administered, or administered via personal or telephone interview. We recommend using large typeset for older adults. An enlarged rating scale on an index card can facilitate interview-assisted administration. Each respondent should be queried to ensure that they understand instructions and rating format.

Instructions for Scoring VPS

Each item is scored from 1 to 5. The total VPS score is calculated by summarizing item scores. Total scores can range from 10 to 50 with higher scores indicating more positive states. Total scores should not be computed unless the person has answered at least 7 of the items. Substitute the mean (total divided by the # items answered) for up to 3 missing values to compute a total score. See Myers (1999) for calculating individual change, in addition to group change scores.

Development and Psychometric Properties of the Vitality Plus Scale

As described in Myers et al. (1999), the VPS was developed in collaboration with older adult exercise participants and instructors. Validation involved multiple samples of exercise and non-exercise groups comprised of both middle-age and older adults. The scale has good internal consistency, one week test-retest reliability, and item-total correlations. Scale scores have been correlated with physical measures and related to sub-scales of the SF-36 to establish convergent and discriminant validity. Preliminary evidence for responsiveness to change is reported for individuals with low to moderate baseline VPS scores prior to participation in a variety of exercise programs (e.g., aerobics, strength training, Tai Chi, aquatics). Improvement is more likely for individuals who are older, have health problems, and/or are less active when starting an exercise program or regime.

Appendix G

Exercise Inventory

Testing Protocol	Type of Test	Measurement	Description of Test	Performance Norms
Balance	Static Balance	Balance	To start, the participant places both hands on the hips and stands on right with the left leg touching the right ankle. The goal is to stand on one leg for 30 seconds. Timing begins when the foot is raised. Timing stops when the hands come off the hips or the foot comes off the ankle.	Time trial. Recording time to see if improvement has taken place.
	Dynamic Balance	Balance	A number of circles will be placed in a line. In the correct order, the participant will step in each circle. Each step is held for 4 seconds and the foot in the center of the circle.	Time trial. Recording time to see if improvement has taken place.
Cardio-respiratory	2 minute Step in Place test	Cardiovascular Strength and endurance	The participant begins to step in place, lifting knees alternately to bring each foot to a predetermined height, and continues for 2 minutes, or as long as the participant can maintain knee lifts. Number of knee lifts is counted in the 2 minutes.	Age Groups: 60-64 M=87-115 W=75-107 65-69 M=86-116 W=73-107 70-74 M=-73-109 W=68-101

				75-79 M=73-109 W=68-100
Muscular Fitness	Sit to Stand	Lower body strength and coordination.	Participant sits on the chair, back straight, feet apart and flat on the floor. The arms are crossed over the chest with hands touching opposite shoulders. The participant is to come to a fully erect stand and then sit down again and lift one foot off the ground. This movement is done for 30 seconds.	Age Groups: 60-64 M=14-19 W=12-17 65-69 M=12-18 W=11-16 70-74 M=12-17 W=10-15 75-79 M=11-17 W10-15

	Biceps Curl Test	Upper Body strength and endurance	Participant is seated in an upright position on the chair with their feet flat on the floor. The weight is put into their hands and the arm tested should not be in contact with the side on the chair. In a down position, the participant will perform a curl through full range of motion and then return to the starting position. The researcher will count the number of curls in 30 seconds.	Age Groups: 60-64 M=16-22 W=13-19 65-69 M=15-21 W=12-18 70-74 M=14-21 W=12-17 75-79 M=13-19 W=10-16
Mobility	8-foot get up and go test	Mobility and agility	The participant begins by sitting on a chair with both feet on the ground. On the "go" signal, the participant walks as fast as possible to the cone, walks around the cone (counterclockwise) and returns to the chair, sits quickly and lifts both feet of the floor. The test ends with the participant sitting on the chair with their feet up. The time recorded to circle the chair and to sit down with their knee up in the air is recorded.	Time trial. Recording time to see if improvement has taken place.

	Strides and speed walk	Stride length and speed	This test is done twice. 32 feet will be measured out on the floor. The participant will begin behind a line at the start and walk 32 feet to the end line. Stride length is recorded. The second test will have the participant walk as fast as possible for 32 feet. Time is recorded.	Time trial. Recording time to see if improvement has taken place.
Flexibility	Chair Sit and Reach Test	Lower body flexibility	Participant will sit on the front edge of a chair, with the crease between the top of the leg and the buttocks even with the edge. Keeping one leg bent at the knee with the foot flat on the floor, the participant extend the other leg straight in front of the hip, with the heel on the floor. A yardstick with a 20" mark at the midpoint will be placed resting on the thigh. Keeping the leg as straight as possible, the participant bends forward from the hip joint, sliding both hands down the yardstick as far as possible toward the toes. The length on the yardstick is then recorded when the participant has reached its lowest point.	Age Groups: 60-64 M=-2.5—4.0 W=-0.5—4.0 65-69 M=-3.0—3.0 W=-0.5—4.5 70-74 M=-3.5—2.5 W=-1.0—4.0 75-79 M=-4.0—2.0 W=-1.5—3.5

	Back Scratch	Shoulder flexibility	The participant stands tall placing one hand on the back over the shoulder with their palm down and fingers pointing downward. The other hand will be placed behind the neck with the palm up and fingers pointed upward. The participant will attempt to bring the hands together to touch the middle fingers. The distance is then measures. A "-" score is for a gap and a "+" is for an overlap.	Age Groups: 60-64 M=-6.5—0 W=-3.0—1.5 65-69 M=-7.5-(-1.0) W=-3.5—1.5 70-74 M=-8.0-(-1.0) W=-4.0—1.0 75-79 M=-9.0-(-2.0) W=-5.5—0.5

Appendix H

Post Interview Questions:

Guidelines:

1. Did you enjoy the water exercise program?
2. What did you like the most and what did you dislike the most?
3. Any suggestions to improve the water exercise program?
4. Do you feel this program has benefited you in any way?
5. Do you feel as if you have improved physically? If yes, in what way?
6. Do you feel as if you have more confidence in doing your daily activities?
7. In your opinion, would you suggest that a water exercise program is useful for the PD population?
8. How did you like the atmosphere in which the program was taught?
9. Do you enjoy being in the water exercising?
10. Do you have any other comments you would like to make about this study?