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The Use of Exercise to Delay the Symptoms of Parkinson's Disease and Improve Quality of Life

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Abstract

Parkinson's disease (PD) is a neurodegenerative disease that disturbs physical, social, functional, and cognitive aspects of life. These aspects are vital components of everyday life and their decline can diminish an individual's quality of life (QOL). QOL can be determined by assessing standards such as walking and self-transportation. This study explored exercise as a method to delay symptoms of PD and raise QOL. Delay the Disease (DTD), a program consisting of strengthening, cardiovascular, and cognitive exercises, was created as a tool to improve QOL and function in people with PD. Functional outcome measures including a 10-meter walk, 5 complete sit to stand chair motions, an 8 foot up and go and right and left single leg stance were measured in 16 Parkinson's patients (average age 70 years). All patients were assessed for time to walk 10 meters, time for 5 complete sit to stand chair motions, time to perform an 8 foot up and go and time to stand on one leg. Times (in seconds) were compared (Students t repeated measure) before and after participation in a 3-4 month DTD program. Participation in DTD reduced the time to walk 10 meters ($p<0.01$) reduced the time to perform the 8 foot up and go ($p<0.05$) and reduced the time to perform 5 complete chair motions ($p=0.01$), while increasing the time patients could stand on one leg ($p<0.05$). The results indicate that DTD exercise programs can improve everyday tasks such as sitting and standing potentially delaying the progression of PD.

Keywords: Parkinson's disease, Exercise therapy, Parkinson's disease treatment

1. Introduction

Parkinson's disease (PD) is a prevalent neurodegenerative disease; its occurrence falls second only to Alzheimer's disease[1]. In industrialized countries, PD has been clinically diagnosed in up to 3% of the population and it affects 1% of individuals over 60 years of age[1]. PD is a disease that affects both men and women, which makes knowledge of it relevant to the entire population. The symptoms associated with PD interfere with the patient's functional abilities and therefore his or her quality of life. Symptoms of PD are both motor and non-motor in nature. Decreased cognitive function is a common non-motor manifestation of PD; it can quickly perpetuate the degeneration of the body as well as reveal other disease processes such as cancer and dementia[2]. The motor symptoms of PD are more visually alarming to both the patient and to others. Hallmark signs of PD include unilateral or bilateral resting hand tremors, dyskinesia, shuffling of the feet, poor balance, and decreased strength as a result of muscular atrophy[1, 2].

PD affects multiple parts of the nervous system such as the central, enteric and peripheral nervous systems[3]. The etiology of PD is comprised of numerous components and has yet to be fully determined. Genetic factors have been found to play a role in PD risk and development[4]. Various loci have been discovered in connection with PD, 11 of which have been found in statistically significant relation[5]. Other factors including pesticides, rural residence, various occupations, head trauma, high fat diets and high calorie diets may increase an individual's risk of

developing PD[2, 6]. Due to the multi-factorial nature of the disease process, a cure has yet to be discovered. While researchers continue to put their efforts towards a cure, others have worked to develop treatments for those afflicted with PD. Medications such as Levodopa have been developed to aid in the fight against the effects of PD. In recent years exercise therapy has become a necessary component of PD treatment.

For many years, exercise was not recommended for PD patients because it was believed that exercise would either have not effect or would make the symptoms of PD worse[7]. Exercise therapy consisting of Parkinson's specific exercises is currently being explored and many healthcare providers are deeming it an essential part of the PD treatment regimen[8,9]. Exercise programs can increase grey matter volume in PD patients and may provide symptom relief, especially impacting symptoms like depression[9, 10]. Delay the Disease (DTD) is one of several large-scale exercise programs designed for individuals with PD. The program incorporates exercises that promote a functional lifestyle, which is vital for personal independence, however DTD classes are only offered in select locations at a cost to families[8, 11]. Because families of PD patients are not likely to pay for and participate in programs with negligible outcomes, this study was designed to track 16 PD patients as they matriculated through a 3-4 month DTD program. It was hypothesized that participation in the program would produce measurable improvements in the ability of PD patients to carry out everyday tasks such as walking 10 meters or standing on one leg. It was also postulated that the functional improvements made by PD patients would raise their quality of life (QOL). This was assessed with a QOL questionnaire similar to the PDQ-39 that included both psychological and physiological questions[12, 13]. Ahlskog[9] and Hirsch[7]have analyzed the ways in which PD specific exercise can benefit an individual with Parkinson's disease[7, 9]. This study continued the examination of exercise as a method to delay and reverse the symptoms of PD.

2. Methodology

2.1 Participants

Sixteen Parkinson's Disease (PD) patients (age range 53-81 years) (7 women and 9 men) participated in a 3-4 month Delay the Disease (DTD) program, a program specifically designed to help PD patients with balance, coordination, strength and cognitive training[8]. DTD classes occurred three times a week and lasted 1 hour. Outcome measures derived from Zid's book of functional exercises and quality of life questionnaires were completed voluntarily before and after completion of the program[8]. Each patient was given individual time to complete each outcome measure. The protocol was approved by the Institutional Review Board (IRB) at Capital University. One patient was excluded due to a leave of absence taken after being hospitalized. Another patient was excluded due to an inability to perform physical outcome measures and lack of compliance to complete the quality of life questionnaire. One patient was excluded from the quality of life questionnaire only due to lack of compliance to complete the questionnaire. The final sample size for the physical outcome measure was (N=14) and the final sample size for the quality of life questionnaire was (N=13).

2.2 Procedure And Statistics

Patients were asked to voluntarily complete physical outcome measures and a quality of life questionnaire upon starting the Delay the Disease Program and upon completion of the 3-4 month program. A 37 question QOL survey, based on Peto's[13] PDQ-39 questionnaire was completed by each participant. Of the 37 questions, 18 physiological and psychological questions covering topics related to feelings of depression, ability to dress oneself and general happiness, were selected for analysis. Physical outcome measures included an 8 foot up and go, a 10-meter walk, a left and right single leg stance and 5 complete sit to stand chair motions. Data are expressed as mean +/- standard error of the mean (SEM). Statistical significance was assessed using Student's t test for independent samples. P values of less than 0.05 were considered statistically significant. The data were analyzed using Microsoft Excel.

2.2.1 8 foot up and go

Patients were asked to sit in a chair and cross their arms over their chest in the shape of an "X". Time in seconds was started when the patient indicated he or she was ready. Patients rose completely from the chair and walked in a straight

line to a cone placed directly 8 feet in front of the chair. Patients rounded the cone on the outer side and walked in a straight line 8 feet back to the chair; time was stopped when the patient was completely and safely seated.

2.2.2 10-meter walk

Patients were asked to walk 10 meters at a safe but quick pace. Time in seconds was started once the patient's foot lifted to cross the 0 m mark indicated on the floor. Time was stopped once the patient's foot crossed the 10-meter mark indicated on the floor.

2.2.3 left single leg stance

Patients were asked to stand with their back facing the wall. Feet were placed a half of a foot from the wall. A chair with rubber grips on the feet was placed one foot in front of the patient and the patient was asked to place his or her hands on the top of the back of the chair. After the patient was balanced, they were asked to raise their right leg off the ground and remove both of their hands when they were ready. Time in seconds was started when the patient removed both hands from the chair, balancing only on their left leg. Time was stopped when the patient placed one or both hands on the chair, placed their right foot on the ground or placed their right foot down and their hand(s) on the chair.

2.2.4 right single leg stance

Patients were asked to stand with their back facing the wall. Feet were placed a half of a foot from the wall. A chair with rubber grips on the feet was placed one foot in front of the patient and the patient was asked to place his or her hands on the top of the back of the chair. After the patient was balanced, they were asked to raise their left leg off the ground and remove both of their hands when they were ready. Time in seconds was started when the patient removed both hands from the chair, balancing only on their right leg. Time was stopped when the patient placed one or both hands on the chair, placed their right foot on the ground or placed their left foot down and their hand(s) on the chair.

2.2.5 5 complete sit to stand chair motions

Patients were asked to sit in a chair and cross their arms over their chest in the shape of an "X". Time in seconds was started when the patient indicated he or she was ready. Patients rose completely from the chair into a standing position using their best posture and sat down completely so that their bottom made full contact with the chair. This motion was completed four more times; time was stopped when the patient was completely and safely seated in the chair for the fifth time.

3. Results

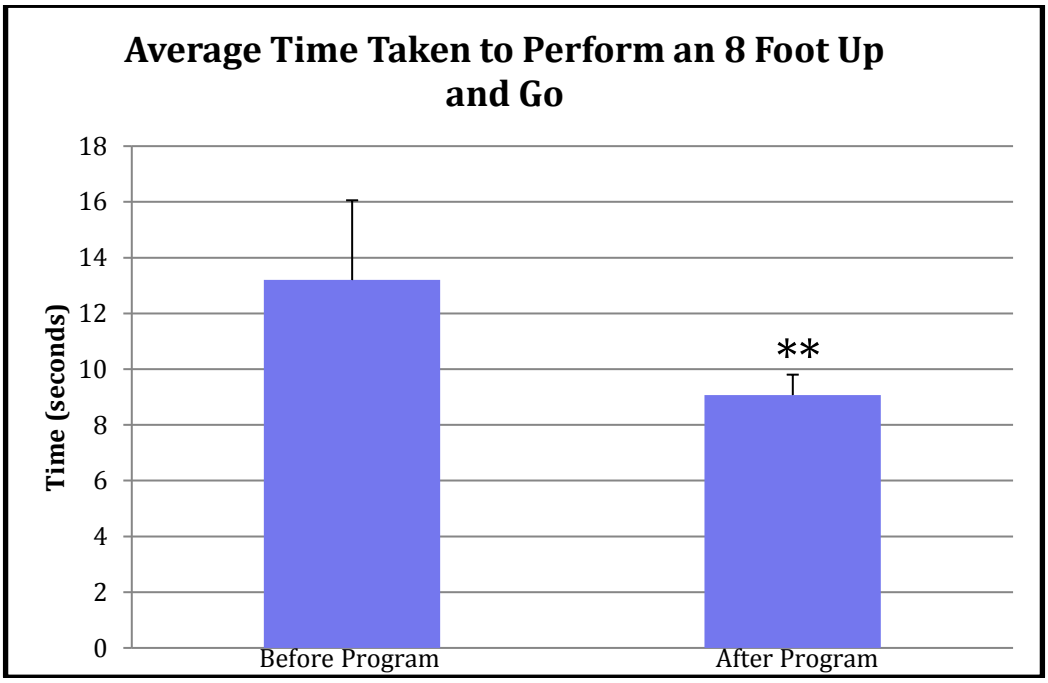

Figure 1. Significant differences were found between the measurements taken before (M= 13.2) and after (M= 9.07) the DTD program ($p<0.05$). All values represented are the means ± SEM. **$p<0.05$

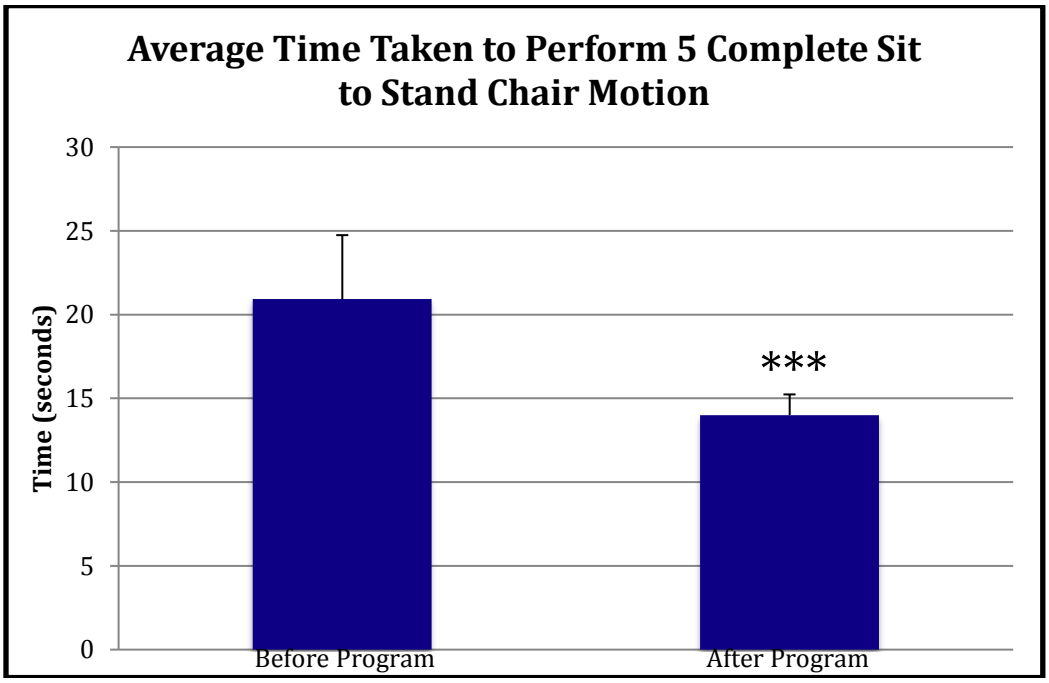

Figure 2. Significant differences were found between the measurements taken before (M= 29.2) and after (M= 14.0) the DTD program ($p<0.015$). All values represented are the means ± SEM. *** $p<0.015$

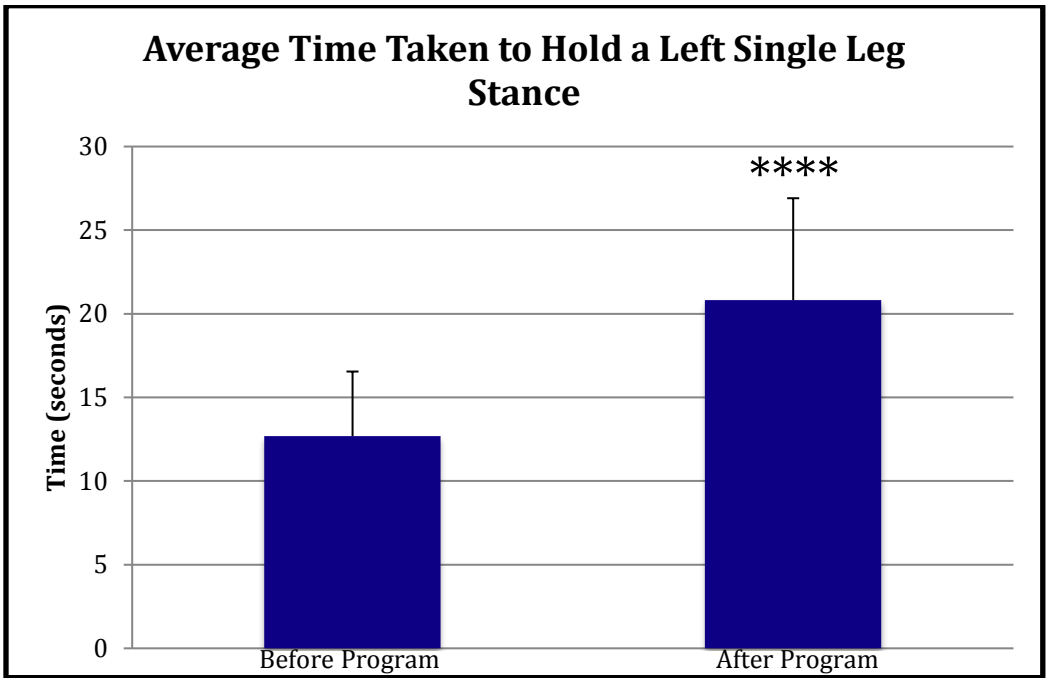

Figure 3. Significant differences were found between the measurements taken before (M= 12.69) and after (M= 20.82) the DTD program (p=0.02). All values represented are the means ± SEM. ****p=0.02

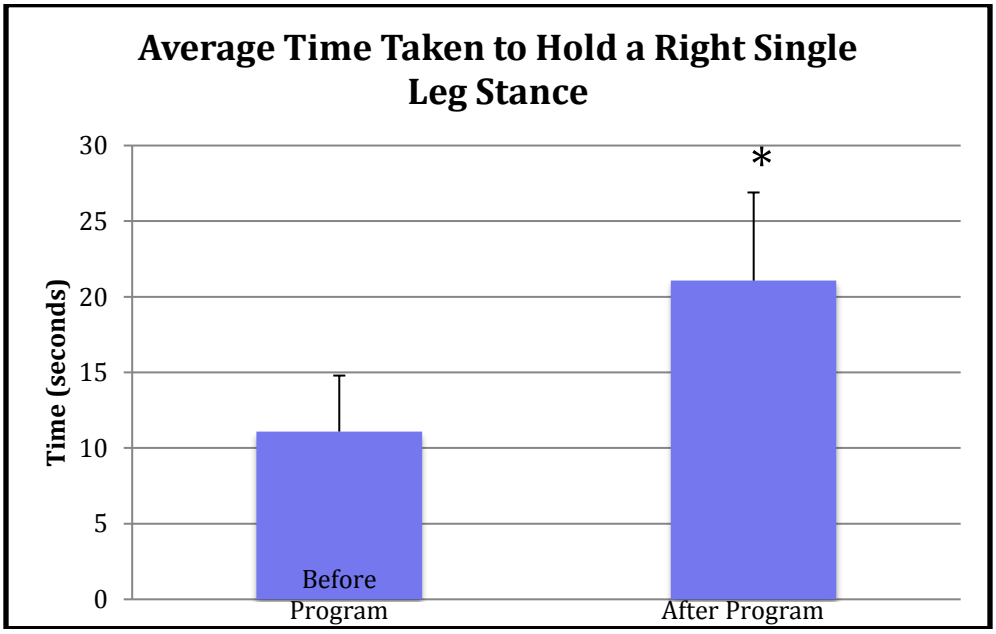

Figure 4. Significant differences were found between the measurements taken before (M= 11.09) and after (M= 21.07) the DTD program (p<0.01). All values represented are the means ± SEM. *p<0.01

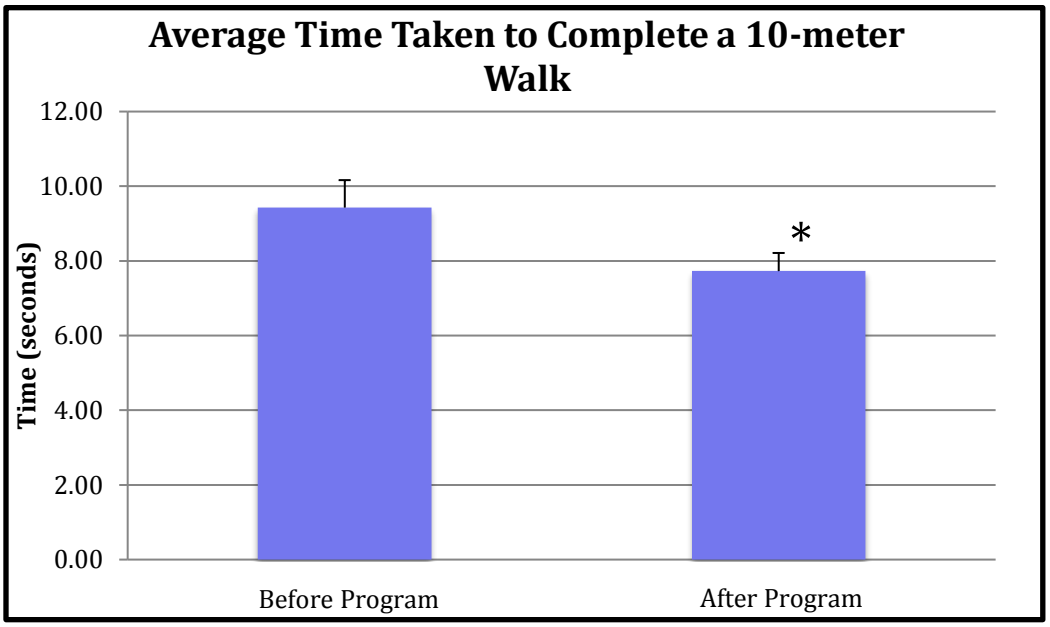

Figure 5. Significant differences were found between the measurements taken before (M= 9.43) and after (M= 7.73) the DTD program ($p<0.01$). All values represented are the means ± SEM. *$p<0.01$

3.1 Physical Outcome Measures

Of the 16 patients, 14 patients participated in functional outcome measures that included the 8-foot up and go, 5 complete sit to stand chair motions, left and right single leg stance and a 10-meter walk. A Student's t-test was used to determine the significance ($p<0.05$) of the data. Statistically significant improvement was noted in all 5 outcome measures. The average time (sec) to complete the 8 foot up and go decreased by 31.28% (Fig. 1). The average time (sec) to perform 5 complete sit to stand chair motions decreased by 52.05% (Fig. 2). The average time (sec) to hold a left single leg stance increased by 64.07% (Fig. 3). The average time (sec) to hold a right single leg stance increased significantly by 90.0% (Fig. 4). The average time (sec) taken to walk 10 meters decreased by 18.03% (Fig. 5).

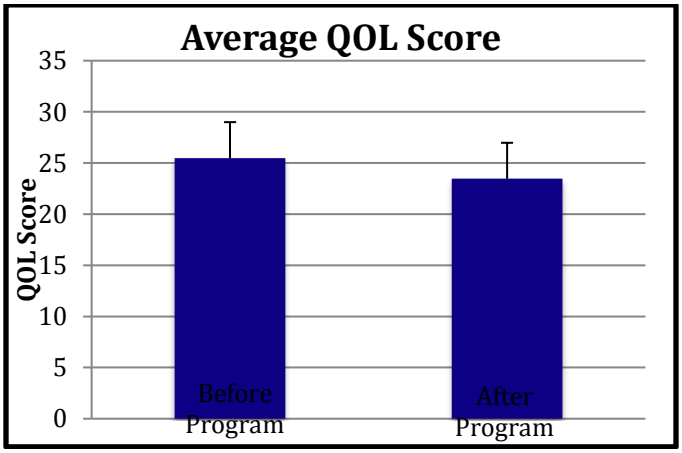

Figure 6. No differences were found between the QOL score taken before (M= 25.46) and after (M= 23.46) the DTD program ($p=0.2$). All values represented are the means ± SEM.

3.2 quality of life questionnaire

Of the 16 patients, 13 patients participated in the completion of the QOL questionnaire. A total of 18 questions in the physiological and psychological categories were selected to be scored based on pertinence to the study. No statistically significant difference was noted as $p=0.2$ (Fig. 6).

4. Discussion of Results

Student's t-test revealed significant differences when functional outcome measures were compared before and after the Delay the Disease exercise program (Fig. 1-5). Patients demonstrated functional improvements at tasks such as the 10-meter walk ($p<0.015$) and the complete sit to stand test ($p<0.01$). The results were supported by other studies[14]. The physical rewards reaped from the outcome measures may be a result of the practice of exercises that target the symptoms of PD. The PD specific exercises prepared patients to perform the 10-meter walk at a faster pace and with improved posture. Prodoehl[15]established significant advances in the sit to stand test ($p=0.0006$) and the 8 foot up and go test ($p<0.0001$) in a 2 year PD physical function study, which was consistent with the progress pattern that was observed in this 3-4 month study as $p<0.015$ for the sit to stand test and $p<0.05$ for the 8 foot up and go. The importance of the statically significant p-value for the sit to stand chair motions is demonstrated in the patient's strength improvement, as he or she was able to decrease the amount of time (sec) that it took to repeat that exercise 5 times. Sitting and standing safely is key to maintaining physical independence and the improvement of this skill allowed patients to complete daily tasks such as getting in and out of their vehicle. The two other physical outcome measures focused on balance, one of the most challenging PD symptoms. The 8 foot up and go test was designed to assess how well a patient could walk and turn, which are two actions that they do multiple times a day. The 5 outcome measures were centered on functional life tasks that patient's need to remain independent.

The results support the knowledge that a combination of strengthening, cardiovascular and cognitive exercises encourage the relearning of daily life behaviors[16]. This study provided more evidence for the case of exercise as an effective treatment for individuals with PD. With the results that have been produced, the aim will be to use neuroplastic effects facilitated by exercise to make everyday behaviors automatic[17]. Functional and cognitive coupled programs similar to DTD have demonstrated improvements in motor tasks; the improvement may provide a better quality of life for an individual with PD due to perceived physical independence[12].

Quality of life questionnaire scores in this study revealed slight improvement at 7.9% (Fig. 6). It was likely that the improvement was due to the holistic program goals. The program goals target strengthening the muscles of the body, challenging the individual's brain and maximizing cardiovascular exercise to improve health and stimulate neuroplastic activity[8, 17]. DTD strived to increase QOL through maintaining and improving the ability to perform daily tasks that allow an individual to remain independent. It has also been found that community-based programs organically create a support system that may increase QOL through the collective act of working to delay the symptoms of the disease with others who have PD and those who do not have PD but wish to provide encouragement[18]. The QOL score improvement was not statistically significant and there are several plausible reasons why that was the case. The first reason was amount of time; 3-4 months may not be enough time for the individual to see substantial change in his or her QOL. Another thought that may help improve the accuracy of the QOL score would be an increase in sample size. A larger sample size would allow for the possibility to tease out differences that may not be found with the smaller sample size. Lastly, personality differences and personal beliefs may alter the patient's perception of his or her QOL.

5. Limitations

This study contained a few restrictions that would ideally be improved in future studies. The sample size was small ($N=16$) due to the enrollment of the classes at the selected DTD class location. The combination of data from several locations may be advantageous. DTD is not a class that is currently covered by insurance and the patients pay out of pocket for it, which means that participation in the outcome measures and QOL questionnaire are voluntary. The patient completion rate for the outcome measures was 87.5% and 81.25% for the QOL questionnaire, which could make a difference when operating with a small sample size.

6. Conclusion

Exercise in structured programs such as DTD provides a neuroprotective effect in patients with PD[9]. The medical teams consisting of doctors, nurses, physical therapists and occupational therapists should be instructing and implementing this treatment as this and many other studies support the use of exercise to delay the symptoms of PD[7, 9, 14, 15]. Exercise is a resource for those who have been diagnosed with Parkinson's disease; it should be used as a treatment in conjunction with Levodopa or other forms of dopamine replenishment, especially in those that have a mild to moderate progression of the disease[9, 17]. There is hope that PD patient treatment needs lie within this combination of medications and exercise. This approach to disease treatment is helpful for PD and may delay or prevent the onset of other diseases.

7. Acknowledgements

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