Wellness Recovery Programs for Individuals with Parkinson's Disease

Introduction

Parkinson’s disease “is the second most common neurodegenerative disease after Alzheimer’s disease” (Farley, Fox, Raming, & McFarland, 2008, p. 100). Research suggests that Parkinson’s disease (PD) is present before motor impairments begin to alter physical functioning. Braak's stages of PD show that the earliest symptoms of PD are constipation and bladder disorders up to 20 years before the onset of physical impairments such as tremors (Hawkes, Del Tredici, & Braak, 2010, p. 80). Prominent symptoms of PD are characterized by cardinal motor signs which include akinesia, rigidity, rest tremor, motor blocks, and postural instability (Meara & Koller, 2000, p. 6). As one could imagine, these characteristics of PD can be stressful, impact balance, physical function, and quality of life. An example of the impact of these symptoms is when an individual is walking to another room and experiences motor block; this results in difficulty rounding a corner, and his or her feet stop moving. The person may begin walking again after a short time or need to be redirected. Many individuals with PD will experience akinesia, or delayed reaction times when they attempt to move certain body parts.

The Hoehn and Yahr Scale (Hoehn & Yahr, 1967) is often used in clinical settings for classifying level of impairment of those with PD. Stage one is the earliest stage and symptoms are mild whereas stage five is the most advanced stage where individuals require assistance with activities of daily living (Hawkes et al., 2010, p. 80). Stage one of the Hoehn and Yahr Scale is characterized by unilateral symptoms of rigidity, slowness, or tremor, and usually involves minimal or no functional impairment (Hawkes et al., 2010, p. 80; Hoehn & Yahr, 1998). Stage two of the Hoehn and Yahr scale is characterized by bilateral tremors, rigidity and akinesia.

Stage three of the Hoehn and Yahr scale is the mid-stage where individuals with PD begin to experience poor balance, and may be restricted in daily activities. At this stage, individuals with PD can still live independently and disability is considered moderate. At stage four, individuals with PD can walk and stand independently, but there is marked impairment (Hoehn & Yahr, 1998). During this stage, individuals with PD are more likely to fall, become dependent on others and decline cognitively (Hawkes et al., 2010, p. 80). The fifth and final stage is characterized by being confined to a chair or bed and onset of dementia is likely (Hoehn & Yahr, 1998).

In the past, patients who were diagnosed with PD have been told that they may never have control over their physical function again, and typically only pharmacological interventions were used to help control symptoms (Doidge, 2015, p. xvii). Certainly, receiving information like this from a health professional would be disheartening. However, new research studies suggest the symptoms of PD may be managed through neuroplasticity principles and potentially slow or reverse some of the experienced symptoms. The principles of neuroplasticity allows the brain to change its structure and function (Doidge, 2015, p. xv). According to Petzinger et al. (2013),

> Neuroplasticity is a process by which the brain encodes and learns new behaviours and is defined as the modification of existing neural networks by addition or modification of synapses in response to changes in behaviours or environment, which can encompass exercise (p. 716).

New studies show that specific exercise may be neuroprotective and even help achieve neuroplasticity (Farley et al., 2008; Petzinger et al., 2013; Hirsch, Hammond, & Hirsch, 2008). Exercises that work to achieve neuroplasticity may be neuroprotective and help rewire the brain as well as preserve dopamine-producing neurons (Doidge, 2015, p. 37).

Neuroplasticity in a Wellness Recovery Programs for Individuals with Parkinson's Disease

According to Farley et al., (2008), at the time individuals are diagnosed with PD, the substantia nigra, which is where dopamine neurons originate, has already lost 70 to 80 percent of function, which exceeds a critical threshold (p. 100). Dopamine plays a crucial role in reward systems for individuals to move or initiate movement, so when dopamine functions are lost, it can substantially impair life functions and ability to initiate movement (Doidge, 2015, p. 90). Dopamine stimulates individuals to function by seeking a reward, such as the reward of moving from one place to another or getting out of bed. Often sequencing functions are also affected, such as the sequence used to wash one's hands. This can be due to a faulty dopamine system in the basal ganglia, and the individual is less motivated to complete the task (Doidge, 2015, p. 59). Since sequencing becomes automatic after it has been learned, often at an early age, it can be difficult to reteach or awaken these systems, therefore, it is imperative to have a strong exercise plan to create neuroplasticity.

Farley et al. (2008) suggests that exercise should begin as early as possible in the disease progression to slow down and possibly reverse the symptoms of the disease (p. 107). Neuroplasticity can target basal ganglia pathology through certain exercise mechanisms (p. 100). The most recent rehabilitation approach is that exercise should include continuous, complex, difficult and repetitious exercises that are amplitude specific (p. 103).

Wellness Recovery Programs for Individuals with Parkinson's Disease

Now that there is a basic understanding of how neuroplasticity can have an impact on motor behavior, and as more research verifies the benefits for individuals with PD, it is critical that this becomes the standard of practice in regards to managing the disease. Several studies

(Farley et al., 2008; Petzinger et al., 2013; Combs et al., 2013) have identified novel, high intensity exercises (LSVT (Lee Silverman Voice Treatment)/LOUD and BIG; goal based aerobic exercise; and intense exercise) that are more effective than regular, non-specific exercise in achieving neuroplasticity for individuals with PD. Timing is additionally important for neuroplasticity to occur.

For individuals with PD, exercise should be intentional and work to achieve desired and specific outcomes. Petzinger et al. (2013) studied exercise models for PD and suggested goal based and aerobic exercise would help achieve neuroplasticity (p.716). They found that individuals with PD begin to have less autonomic control of sequenced functions, and therefore must try to achieve them consciously. individuals with PD should practice goal based exercise in the same way individuals learn, with "intensity, repetition, specificity, difficulty, and complexity" for optimum results, as this challenges and stimulates the brain and body (Petzinger et al., 2013, p. 717). Cognitive engagement as an additional piece to exercise may also have neuroprotective effects (p. 717). Therefore, being provided with feedback allows clients to make keen observations of their own movement. Clients may also be asked to perform two tasks at once or be applauded for great achievement to provide cognitive stimulation (p. 717). Aerobic exercise helps improve blood flow, facilitate neuroplasticity, and assist with behavioral function (Petzinher et al., 2013, p. 716).

Farley et al. (2008) looked at intensive amplitude-specific therapeutic approaches for PD which includes the use of neuroplasticity exercise approaches that provide a challenge to compromised dopamine systems. They found that exercise works to stop or slow cell death, enhance behavioral recovery (e.g. successful navigation of rounding a corner), and protect against neural events of aging and neurodegeneration. (p. 101). Results found that exercise was linked to higher levels of Glial Derived Neurotrophic factor (GDNF) (p. 101). They suggested "progressively higher intensity, velocity, longer duration, practice, and task-specific paradigms may be required" (p. 101) to achieve these neuroplastic effects and elevated levels of GDNF. The release of GDNF supports plasticity in the dopamine system, therefore, awakening dopamine neurons (p. 101). Farley et al. looked specifically at the LSVT/LOUD and BIG (Lee Silverman Voice Treatment) program which works on voice amplification (LOUD) and limb motor systems (BIG). They found it helpful in improving trunk rotation and stride length, gait and reaching velocity, as well as quality of life (p. 105). The LSVT/LOUD and BIG program required a participant perceived effort level of 8 out of 10 as well as intensive and repetitive practices that became progressively more difficult. Additionally, they created a program that focused on limb and speech motor systems in PD (p. 107).

A study by Combs et al. (2013) compared boxing and traditional exercise for individuals with PD. In this study, participants were either assigned to a traditional exercise program or boxing classes. In the traditional exercise program, there was a 15 minute warm up of stretching, and active range of motion; one hour of strength, endurance and balance exercises; and a 15 minute seated cool down with breathing exercises, similar to the warm up (p. 118). During the boxing program, participants were assigned to pre-existing boxing programs that included a 15 minute warm up, much like the traditional group, an hour of boxing-specific activities, which was self-progressed, and participants were encouraged to do the maximum amount of reps at the highest level of intensity they could (p. 119).

Specific Wellness Recovery Programs for Individuals with Parkinson's Disease

Based on the findings of several research studies, clinicians can make suggestions for an exercise Wellness Recovery Program for individuals with PD to work towards neuroplasticity and improvement or reduction of symptoms. An important note is that research has found the timing of these specific exercise programs to be vital to the ability of the brain to experience neuroplasticity and carryover (Farley et al., 2008, p. 105; Hirsch et al., 2008, p. 96). It is suggested that specific exercise should begin upon diagnosis to experience maximum benefits from exercising (Farley et al., 2008, p. 107).

There are many similarities between exercise programs that had the greatest benefits for individuals with PD. First, task-specific programs and exercises in previous studies were found to have significant benefits. In the study by Farley et al. (2008), they found that tasks should be difficult and require skill acquisition (p. 103). Petzinger et al. (2013) studied exercise that was goal based, practicing certain activities, and dual tasks (p. 716). Hirsch el al. (2008) concluded that specific tasks triggered plasticity changes in the brain (p. 93). Additionally, Doidge (2015) described a man with PD who alleviated his symptoms through a specific walking program in which he re-trained his brain to walk correctly (p. 57). The boxing and traditional exercise programs from Combs et al. (2013) also focused on specific achievements (p. 118). Task specific training can be done with any task that needs improvement, but outcomes should be intentional and expected.

Exercise training for individuals with PD should be repetitive. As with learning any skill or memorizing a sequence, the more a person practices, the better he or she will become at that task. Doidge (2015) provides an example of how our actions when learning bypass the basal ganglia, where sequencing comes from, when consciously paying attention. He uses the example of a child learning to play the piano; at first the child must consciously think about it and the sequence is not automatic, but as he or she practices more, this sequencing is stored in the basal ganglia, and he or she can play practiced notes with little conscious effort (p. 60). Another example of our actions bypassing the basal ganglia would be learning to ride a bike. At first a person learning to ride a bike must concentrate and put forth a significant amount of effort to keep balance, but after a bit of practice, it becomes a sequence that is stored in the basal ganglia and can be executed with minimal effort. Other studies by Farley et al. (2008) prescribed repetition to help generalize the task with one focus (p. 104). Petzinger et al. (2013) and Hirsch et al. (2008) also found that repetition played a role in creating neuroplasticity in their studies (p. 717, p. 94).

Additionally, most of these studies noted that intensity was a key factor in creating neuroplasticity. Farley et al. (2008) suggested that normal training helps create neuroplasticity, however, for lasting effects of the exercise program, an increased intensity is imperative (p. 104). Combs et al. (2013) observed that functional capacity improved in two of three individuals in an intensive boxing program (p. 121). Hirsch et al. (2008) also found in their research that "regular bouts of high intensity may be neuroprotective" (p. 94). Petzinger et al. (2013) suggested that neuroplasticity is experience dependent and that high intensity was crucial to neuroplasticity and cognitive circuitry (p. 717).

Functional outcomes of specific programs created to achieve neuroplasticity

There were several outcomes of the studies mentioned previously (Farley et al., 2008; Petzinger et al., 2013; Combs et al., 2013) that are notable or show areas for improvement in future research studies. From these studies, researchers have been able to pinpoint some valuable aspects of their exercise programs as well as limitations of their studies.

Previous studies have looked at either aerobic exercise or goal based exercise for individuals with PD. The research by Petzinger et al. (2013) hypothesized that neuroplasticity would increase when participants with PD were involved in goal based and aerobic exercise. Petzinger et al. (2013) hypothesized that "the combination of these two types of exercise might provide synergistic benefits not seen with either alone" (p. 718). Exercise promotes neuroplasticity and may help restore automaticity of movements which is the ability to execute a movement such as getting out of the bed. Studies suggest that aerobic exercise may be imperative in achieving neuroplasticity as a way of promoting the restoration of automaticity, however, further research is required to confirm the benefit of aerobic exercise to help restore automaticity. There is also evidence that the use of goal based exercise and aerobic exercise combined can restore neuroplasticity in the striatal-thalamic-cortical-motor circuit which is responsible for automaticity (Petzinger et al., 2013). Aerobic exercises Petzinger et al. studied showed improvements in stride length and gait, and automatic manual dexterity.

The study by Farley et al. (2008) evaluated the LSVT/BIG program which consisted of 18 subjects in the LSVT/BIG exercise program and a control group of 11 individuals with untreated PD of the same age. All subjects were between stages one and three on the Hoehn and Yahr scale. The LSVT/BIG program's goal was to teach individuals with PD to move naturally in a way that would provide continuous exercise (Farley et al., 2008). The program was four days per week for four weeks where therapists pushed participants to perform at a client perceived effort level of eight, strive for more repetitions, and complete complex exercises. The study evaluated the impact of the LSVT/BIG program on trained tasks which included trunk rotation and stride length, and untrained tasks which included gait and reaching velocity. Both improved significantly short term, as well as improvements in preferred walking velocity, stride length and functional axial rotation were also significantly different at a three month follow up compared to baseline. The subjects were also able to better complete dual tasks after follow up than other individuals their age. Additionally, the improvements in bradykinesia “generalized to significant clinical improvements on the activities-balance-confidence scale and in quality of life using the summary score from the PD Questionnaire” (Farley et al., 2008, p. 105). Subjects with milder impairment made greater improvements in gait velocity than those who were in more severe stages of the Hoeh and Yahr scale.

The LSVT/BIG study was extended to target both speech and motor systems trough LSVT/BIG and LOUD combined as one treatment. Researchers hypothesized that amplitude specific voice and motor exercises delivered simultaneously would be complementary and enhance functioning in specific behaviors. Their proposal for this study was that

> LSVT/BIG and LOUD may be analogous to a paired motor training paradigm such that increased activation required for greater amplitude for on task (louder speech) may induce an increase in excitability of common circuitry that is further enhanced by the addition of another amplitude task (bigger whole-body movements) Farley et al, 2008, p. 108.

LSVT/BIG and LOUD program was completed by 11 individuals with early PD. After participating in the program, there were significant improvements in loudness (vocal sound pressure) during sustained vowels and reading, and increased velocity and stride length during preferred walking. Farley et al. (2008) reports that the “gains in vocal loudness and gait were comparable to previously published data from earlier studies that targeted speech or limb movements independently” (p. 108). In addition to specific speech and motor improvements, the study showed a 28% decrease in the severity of the motor symptoms of PD based on the Unified Parkinson’s Disease Rating Scale and improvement of 27% in quality of life of participants on the Parkinson’s Disease Questionnaire-39. A 30% improvement on the Unified Parkinson’s would be considered clinically significant, so this is evidence that neuroprotective agents should be investigated. Farley et al. suggest that further studies should be conducted to determine whether or not the studies have better effects when combined or delivered individually.

Combs et al. (2013) completed a randomized control trial to compare the effects of a boxing intervention and a traditional exercise program. The traditional program began with a 15 minute warm up in which participants engaged in seated exercises such as “multi-planar axial and extremity active range of motion and stretching” (Combs et al., 2013, p. 118). Following the warm up, the traditional exercise program consisted of endurance exercises such as walking at their own pace or stair climbing; strengthening exercises such as resistance training; and balance activities such as “multidirectional reaching, static and dynamic standing balance on discs and rocker boards and negotiating an obstacle course” (p. 119). The trainers encouraged participants to move through their full range of motion during activities and the exercise ended with a 15 minute cool down with relaxation and breathing techniques. Participants in the boxing group joined pre-existing boxing classes that consisted of a 15 minute warm and then participated in a boxing circuit that was self paced, but participants were encouraged to train as intensely as they could tolerate and complete as many repetitions as possible. There was a statistically significant difference indicating that the traditional exercise group perceived more improvement in their balance confidence after the training. No other outcome measures demonstrated a significant difference, however, Combs et al (2013) reported a notable trend in gait endurance stating that the boxing group had a statistically significant increase in distance walked on the Six Minute Walk Test and the traditional group had a decrease in distance walked. Both the traditional exercise group and the boxing group had statistically significant improvements functional standing balance over time; standing and walking three meters; standing and walking three meters while counting backward, and quality of life. Further studies that are more specific in training regimine need to be conducted.

Improving balance for Individuals with Parkinson's Disease in future practice

Often, individuals with PD experience some type of balance issue due to shorter gait, freezing, or other factors. As individuals age, an they become more susceptible to falls, professionals need to be aware of the causes of falls in older adults. Exercise programs should use evidence based practices to enhance balance. Particularly, adults with PD may be more likely to experience balance problems in the third stage of the disease.

A study by Bloem, De Vries and Ebersbach (2015) reviewed a total of 31 randomized control studies completed since 2013 that focused on nonpharmacological interventions for persons with PD. The major topics were categorized into physiotherapy and exercise (18 studies); dance interventions (3 studies); cognition and behavior (6 studies); occupational therapy (2 studies); and swallowing therapy (2 studies). The authors concluded that the studies provided "... increasing evidence base that places nonpharmacological treatments firmly within the integrated repertoire of treatment options in Parkinson's disease" (p. 1504).

Bloem et al. (2015) findings from various studies provide an understanding for how a variety of interventions can improve balance in individuals with PD. Studies that involved execution of tasks with high intensity and strength training usually helped improve balance and reduce falls. Further studies need to be evaluated to determine how to best help individuals with PD improve balance. Bloem et al. (2015) suggest creating personalized interventions to avoid adverse events as well as individualize treatment approaches based on participant needs.

Strenuous exercise may prevent P arkinson's Disease

There are many benefits to exercising, such as maintaining a healthy weight, cardiovascular health, strength, and being able to complete various tasks, but it also has benefits that are perhaps even more appealing. Research suggests that individuals who exercise early in life are less likely to develop PD as they age (Petzinger et al., 2013, p. 716). Early nonuse may make degeneration of a person's capabilities in functioning more likely (Farley et al., 2008, p. 105). Furthermore, there are now programs such as RESCUE that strive for early detection and takes a preventative approach of exercising in order to make individuals less likely to develop PD (Hirsch et al., 2008, p. 96).

Animal studies found that animals forced to exercise before or upon onset of diagnosis of PD were more likely to experience neuroprotective effects which inhibited cell death and increased GDNF (Petzinger et al., 2013, p. 721). Another study on rats injected with PD required rats to exercise right after injection, and there was more sparing of dopaminergic neurons and less severe symptoms of PD (Hirsch et al., 2008, p. 93). Individuals who choose to exercise upon diagnosis of PD may be able to stop bilateral progression by exercising (Farley et al., 2008, p. 101). Because of neuroplastic principles, bilateral progression may be slowed or delayed, as exercise can re-awaken pathways.

PWR: An established Wellness Recovery Program for Individuals with Parkinson's Disease

Parkinson's Wellness Recovery (PWR) program is an exercise based program that uses evidence based practices similar to those noted above to achieve neuroplasticity to "reduce symptoms, restore function, and improve quality of life, with the promise to slow disease progression" (Parkinson Wellness Recovery, 2018). Trainers are typically recreation therapists, physical therapists, or occupational therapists working directly with individuals with PD. There are four basic moves this program uses that can be integrated into other exercise approaches to PD or can be used as they are in rehabilitation settings with task specific training. The four basic moves are antigravity extensions, weight shifting, axial mobility, and transitions. These can be used to "improve mobility, increase physical capacity, or reduce freezing" and have been proven to have protective effects for the brain, as well as create neuroplasticity (Parkinson Wellness Recovery, 2018).

There are specific strategies that certified PWR moves instructors utilize, that not surprisingly are similar to suggestions made by the research. PWR moves instructors believe that "what you do matters" (Parkinson Wellness Recovery, 2018). They use the four basic PWR moves for aerobic exercise and skill training. PWR moves also places emphasis on how individuals with PD exercise. Much like Doidge (2015) explains that individuals should pay close attention to every detail of movement with a conscious mind, PWR moves instructors also encourage their clients to pay attention to the quality of their movement and be continuously engaged and challenge themselves physically (Doidge, 2015, p. 57; Parkinson Wellness Recovery, 2018).

Finally, Dr. Farley, the founder of PWR moves makes suggestions for optimal brain change. First, there should be a challenge (Parkinson Wellness Recovery, 2018). Tasks should be unpredictable, complex, dual tasks, and require the client to make quick decisions. This will require the client to not only be reactive, but take a proactive approach, which creates new ideas for themselves rather than going by a sequence, which is where they usually encounter “blocks”. Exercise programs for individuals with PD should also require a substantial amount of attentional focus to provide a cognitive challenge; to pay attention to the quality of their movements; and to evaluate their physical performance (Parkinson Wellness Recovery, 2018). This will help individuals with PD become more aware of their actions and perhaps reawaken dopamine pathways.

Summary

Individuals with PD are usually shown compensatory strategies in which bypass the basal ganglia where dopamine is found. Although this works to some extent, as individuals with PD have a faulty dopamine system, intense and amplitude specific training has shown to be able to create neuroplasticity of the dopamine system. When a person with PD is asked to complete a task they are struggling with because of non-responsive dopamine cells, the cells reawaken dopamine pathways by training these behaviors again, therefore developing a sequence. Recent studies suggest that individuals with PD should exercise early in the disease progression in order to reach neuroplasticity. A program called PWR was developed based on research that incorporates intense, amplitude specific, high repetition exercise into a program that is meant to help achieve neuroplastic effects of dopaminergic pathways. Individuals with PD are encouraged to be involved in exercise programs in order to maintain and improve functional capacity.

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