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# **Does Resistance Training Improve Mobility in Patients with Parkinson's Disease?**

F. Joe Yorio

A SELECTIVE EVIDENCE BASED MEDICINE REVIEW

In Partial Fulfillment of the Requirements For  
The Degree of Master of Science

In

Health Sciences – Physician Assistant

Department of Physician Assistant Studies  
Philadelphia College of Osteopathic Medicine  
Philadelphia, Pennsylvania

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## Abstract

Objective: The objective of this selective EBM is to determine whether or not resistance training is effective in improving mobility for patients with Parkinson's disease.

Study Design: Review of four English language randomized control trials (RCT) published between 2012-2013.

Data Sources: Articles used were RCTs and published in peer reviewed journals and found using Pubmed, JAMA, and NCBI.

Outcomes Measured: Effectiveness was measured by comparing a sham, or non-resistance based exercise group, to a resistance based group. Improvement in mobility was measured using UPDRS-III scores.

Results: Patients with Parkinson's have slow and weak movements which should be improved with resistance training. Corcos et al showed that resistance training improved UPDRS-III over a comparison group with a mean difference of 7.3 points ( $P < 0.001$ ). Shulman et al showed that a stretching and resistance group decreased UPDRS-III scores by 3.5 points ( $P < 0.05$ ) compared to a control group. Park et al showed that the experimental group did not show improvement over a comparison group based on UPDRS-III scores and did not have clinically significant outcomes ( $P = 0.80$ ).

Outcome: Resistance training is likely to improve mobility in patients with Parkinson's Disease when compared to control groups and with a minimal risk of harm.

Key Words: "Parkinson's Disease," "Resistance training," "Treatments."

## **Introduction**

Parkinson's Disease (PD) is the second most common neurodegenerative disease in the U.S. PD changes the lives of patients affected through a series of symptoms which decrease mobility and independence. The pathognomonic symptoms of the disease are tremor, weakness, rigidity, bradykinesia, and gait disturbance; all of which contribute to a decrease in patient mobility.<sup>1</sup> These disturbances are thought to be caused by a deficiency in dopaminergic neurons. In patients with PD, these neurons are found to be depleted and those remaining contain Lewy body inclusions in the substantia nigra.<sup>1</sup> There is also reduced cerebral blood flow and blood oxygenation dependent activation in the striatum, prefrontal cortex, and supplementary motor area.<sup>2</sup> This means that when attempting motor skills, basal ganglia neurons of PD patients are hypoactive; reducing function.<sup>2</sup>

PD is an enormous financial and resource burden on the U.S. health system. According to Kowal et al,<sup>3</sup> Parkinson's disease affects around 630,000 people in the U.S. and will double by the year 2040. In 2010 this disease contributed \$14 billion to health care costs and is expected to increase with a growing elderly population.<sup>3</sup> In 2010, PD patients incurred 1.26 million physician office visits and 31,000 emergency department visits.<sup>3</sup> Additionally, 9% of nursing home patients had a diagnosis of PD.<sup>3</sup>

Parkinson's is more common in men than in women, and risk factors include old age, family history, rural lifestyle, and pesticide exposure.<sup>4</sup> While the exact cause is unknown, it is believed to occur from a combination of genetic and environmental influences.<sup>4</sup> Most patients initially present between 55-65 years old with resting tremor being the most common initial

symptom.<sup>4</sup> Diagnosis is made clinically with the signs of tremor, gait disturbance, rigidity, and bradykinesia.<sup>1</sup>

Current treatments are non-curative and focus on improvement of motor symptoms. The current recommended pharmacologic treatment is Levodopa; a dopamine precursor shown to improve activities of daily living (ADL) and motor function.<sup>1</sup> Other pharmacologic treatments are dopamine agonists such as pramipexole, ropinirole, or bromocriptine. These are less effective but have no dyskinesia side effects.<sup>1</sup> MAO-B inhibitors and Amantadine are also used for early symptoms but have moderate effects.<sup>1</sup> Surgical treatment is reserved for severe cases and consists of deep brain stimulation by implantable electrodes.<sup>1</sup> Exercise therapy is also used consistently to alleviate symptoms and is most beneficial when implemented early. Different exercise routines have been studied such as treadmill walking, Tai Chi, and resistance training. Resistance training is performed by short periods of muscle contraction against an external force with intermittent rest; sometimes referred to as high intensity exercise. This can be performed in a fitness center or at home with minimal training. Because of this it can be easily recommended by a healthcare provider at early signs of PD. Determining the efficacy of this training to improve motor symptoms is the focus of this review.

Resistance exercise therapy is thought to benefit PD in two ways. Repetitive force production by muscles has been shown to increase neuronal activation in the basal ganglia.<sup>5</sup> It also increases blood-oxygen-level dependent signaling in this region as well as the motor cortex, leading to improvement in motor function.<sup>5</sup> Both areas are thought to be impaired in PD

patients. In addition, exercise therapy has shown to increase muscle strength and perceived quality of life; essential aspects of mobility for anyone with a chronic illness.<sup>6</sup>

It is reasonable to think that this type of treatment can improve mobility in patients with early, non-debilitating symptoms of PD, and can easily be recommended by midlevel providers such as Physician Assistants and Nurse Practitioners. If resistance based exercise programs are successful in improving mobility, they would have a direct impact on patient lives and may even improve the economic and resource burden of Parkinson's.

The RCTs reviewed here focus on initiating a resistance based exercise program in patients with early symptoms of PD compared to either non-resistance type, or sham routines. The measurement outcomes of interest are centered on a patient's ability to maintain mobility, which would significantly improve lifestyle. Along with the physical and mental health benefits of resistance training, implementing this type of treatment is a cost effective and practical treatment approach that is within the scope of practice of midlevel and advanced providers.

## **Objective**

The objective of this selective EBM is to determine whether or not resistance training is effective in improving mobility in patients with Parkinson's disease.

## **Methods**

The selective research studies chosen had to meet specific criteria in order to be included in this review. The population studied must have been patients over 40 with mild to moderate Parkinson's disease with gait impairment and postural instability and they must maintain

physical independence. Exclusion criteria included cognitive impairments, comorbidities preventing exercise, and patients already performing an exercise routine. The studies measured change from baseline mobility of an experimental group and a control group. Mobility measurements included the Unified Parkinson's Disease Rating Scale with motor sub category (UPDRS-III). Exercise group assignments must have been randomized and patients blinded to which group they were in. Studies were written in English and published in peer reviewed journals that could be retrieved through Pubmed, JAMA, and NCBI, and were published no earlier than 2012. Search terms used were "Parkinson's Disease," "Resistance Training," and "Treatments." Statistical analysis compared mean mobility test scores at baseline and treatment completion. The studies included standard deviations, p-values, and confidence intervals. Numbers needed to harm (NNH) with relative (RRI) and absolute risk increase (ARI) could be calculated in one of the studies.

Table 1: Demographics and characteristics of studies

Study	Type	Pts	Age	Included	Excluded	W/D	Intervention
Corcos et al. <sup>5</sup>	RCT	48	50-67	PD, dopaminergic therapy, stable gait	Cognitive impairment, co-morbidities, MMSE<23, current exercise routine, PD surgical treatment	10	Progressive resistance exercise program (PRE)
Shulman et al. <sup>7</sup>	RCT	80	>40	PD, Hoehn and Yahr 1-3, gait impairment	MMSE <23, unstable, co-morbidities, unable to walk/exercise	13	Resistance Training

Park et al. <sup>8</sup>	RCT	31	40-70	PD with Hoehn and Yahr stage 1-2	Secondary condition, Hoehn and Yahr > 3, taking levodopa	1	Strength training
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### Outcomes Measured

The outcome measured to demonstrate mobility in these studies were change from baseline UPDRS-III score. The UPDRS-III motor subscale is graded by an examiner who rates a score of 0 for normal, 1 for slight, 2 for mild, 3 for moderate, and 4 for severe as a test taker performs specific skills. These skills include speech, facial expression, resting tremor, action tremor, rigidity, finger tapping, hand movement, pronation/supination, leg agility, arise from chair, posture, gait, posture stability, and bradykinesia. The lower the UPDRS score, the less disabled a person is. This scoring system is valuable because its components consist of tasks deemed necessary for patients to maintain mobility in their daily lifestyle. It is also easy to understand that maintaining these motor functions relates to a wide variety that might be required every day in order to maintain physical independence.

In all studies chosen, patients were scored at baseline using the above measurements and scores were combined using a mean group score. Experiment and control groups performed the assigned exercise programs and UPDRS-III was scored again to measure change from base line. Because PD is a progressively disabling disease, maintaining or decreasing the mobility score over time would be considered a successful treatment plan. An increase in score would show worsening disease progression and no treatment effect on disease symptoms.

### Results

Corcos et al began the study with 48 patients from Rush University Medical center and performed the evaluations at the University of Illinois Chicago. Patient's level of mobility was assessed by movement disorder specialists. The experimental groups performed an 11 exercise progressive resistance program targeting all major muscle groups and the control group performed a balance and non-progressive strengthening program. Patients were assessed by blinded raters using UPDRS-III scores then randomly assigned to groups. UPDRS-III scores were assessed periodically and at the end of a 24 month period. At 24 months, the control group decreased its mean score by  $-0.1 \pm 8.7$  and the experimental group by  $-7.4 \pm 7.4$ . After evaluating adverse events due to the training program, the experimental group resistance routine had a NNH value of 1 injury per -333.3 patients. Since this is a negative value, it means that 667 people need to participate in this training for 1 injury to occur due to training. The relative risk due to injury is -5.7% compared to the control exercise, and absolute risk is -0.3%. This means that in this study there is greater risk for injury in the sham exercise group than the experimental group

Table 2: Corcos et al UPDRS-III resistance training change from baseline

Group	Baseline Mean $\pm$ SD	24 mo Mean $\pm$ SD	Change from baseline with CI 95%	p-value
Control	34.7 $\pm$ 11.5	34.0 $\pm$ 12.6	-0.1 $\pm$ 8.7	<0.001
Experimental	34.5 $\pm$ 11.9	25.8 $\pm$ 10.6	-7.4 $\pm$ 7.4	

Table 3: Corcos et al Numbers Needed to Harm

RRI	ARI	NNH
-5.7%	-.3%	-333.3

In the study by Shulman et al, a three group comparison of resistance, high intensity, and low intensity treadmill exercise were studied. Participants were recruited by the University of Maryland Medical School and assessments were performed at the Baltimore Veteran Affairs hospital. Eighty participants with PD were randomly assigned to one of the three groups. The resistance group performed two sets of 10 repetitions on three different leg exercises three times each week for three months and treadmill groups performed 30-50 minute walking sessions on a treadmill for the same duration. Baseline and three month UPDRS-III mean scores with standard deviations were obtained. One-way analysis of variance was used in baseline comparisons between groups and post hoc analyses were used for significant changes in group scores. Only the resistance group UPDRS-III change from baseline scores were reported; -3.5 and p-value <0.05. The threshold for a minimally important difference determined by the authors was -2.5 points. They reported no change from baseline scores in the two treadmill groups

Park et al performed a study using a delayed start design. This study recruited 31 PD patients and randomized them to groups. Fifteen to the early start group (ESG) and 16 to the delayed start group (DSG). The first six weeks consisted of cardio, core, and joint integrity to prevent injury, then the next six weeks focused on strength training. In the second phase, the first two weeks re-focused on cardio/core/joint, then the remainder of the program was devoted to strength. The cycle was repeated and the delayed start group began the routine. Workouts were led by a personal trainer and lasted for one hour, three times each week. Groups mean

UPDRS-III scores with standard deviations were measured at baseline and throughout the study. At the end of the study, UPDRS-III scores did not improve for either group. At 24 weeks, UPDRS-III results were insignificant; the ESG increased  $2.13 \pm 5.43$  and the DSG was  $0.00 \pm 7.45$  with a p-value of 0.49. At the end of the trial the ESG mean score increased  $5.80 \pm 4.02$  and DSG increased  $5.27 \pm 7.42$  with a p-value of 0.80. The results of this trial did not show an improvement in mobility.

Table 4: Mean UPDRS-III with SD for Park et al ESG and DSG strength training groups

Group	Baseline	24 wks	Change	p-value	48 wks	Change	p-value
ESG	$14.00 \pm 5.73$	$16.13 \pm 6.86$	$2.13 \pm 5.43$	.49	$20.40 \pm 7.01$	$5.80 \pm 4.02$	.80
DSG	$16.60 \pm 7.20$	$16.60 \pm 8.72$	$0.00 \pm 7.45$		$21.87 \pm 10.43$	$5.27 \pm 7.42$	

## Discussion

A recurrent problem in all of these studies is that patients may suspect that they are in an experimental or control group based on the type of exercise they are performing. In the studies reviewed, the control groups were given a different exercise which seems to have been an acceptable way of disguising the control group. Another potential weakness is that the UPDRS-III relies on a rater to assign a subjective value of symptom severity. While raters were blind to group randomization, assuring that the same raters were used for congruency would have improved the quality of the studies.

In the study by Corcos et al, three patients withdrew from the control group after randomization but were replaced before assessment. After the study measurements began, no

patients were replaced or added to the groups. The experimental group had 20 complete training and the control had 18. One patient from each group withdrew due to exercise related injury. By calculating the injury event rate in this study, the RRI, ARI, and NNH could be determined for this review and is reported in table 3. With a NNH of -333.3 patients per 1 injury, the risk of an adverse event performing this exercise will occur one time for every 667 patients. Patients that withdrew for unrelated reasons were not included. This study perhaps had the most significant results showing that after 24 months, the progressive resistance training group did 7.3 points better compared to the control group on UPDRS-III scores. By lowering the UPDRS-III motor scale 7.4 points, the experimental exercise program implemented in this study has shown to improve mobility in PD patients. Even with the SD of 7.4, simply maintaining baseline scores over 24 months with a progressive disease can be considered effective treatment.

In the Shulman et al study three patients withdrew from the stretch and resistance group due to possibly related medical issues with 22 completing the trial. There were no medical related withdrawals from the low intensity treadmill group with 22 completing the trial. There was one withdrawal from the high intensity treadmill group possibly due to exercise and 23 completed training. Injury risk data could not be determined in this study because the comparison is among three different types of exercises. The researchers determined that a clinically important difference of -2.5 points on the UPDRS motor subscale would be necessary to show efficacy of a treatment. They reported that the both treadmill groups failed to meet this difference but did not report exact scores. Only the stretching and resistance group demonstrated improvement in mobility as demonstrated by a 3.5 point decrease in UPDRS-III motor score with a 95% CI and  $p < 0.05$ .

In the study by Park et al, only one patient withdrew in week 32 from the delayed start group not related to exercise, leaving 15 patients at final evaluation. The early start group had no attrition and finished with 16 patients. The delayed start design allowed for researchers to compare the intervention being tested to a non-exercise control group as well as show the benefits of starting an intervention earlier. This is beneficial in a disease such as PD in which symptoms are chronic and progressively worsen over time. The results of this study were inconclusive. This study failed to show an improvement in UPDRS-III scores in any group. The small sample size may have attributed to this. The failure to show statistical significance, using 95% CI with p-value of 0.80, cannot prove or disprove the efficacy of this treatment protocol. Results of this study are reported in table 4.

## **Conclusion**

Based on the evidence examined in these studies, resistance training is likely to improve mobility in patients with PD. Despite two of the three studies lacking statistically significant data, the evidence in the other studies show improvement in mobility based on UPDRS-III score. The evidence not supporting this preventive treatment does not seem strong enough to cast doubt on the other studies. Furthermore, implementing resistance training is an easy addition to a patient's daily routine. All of the studies performed showed the negative impact of resistance training was minimal and therefore the potential benefit of therapy exceeds any potential risk.

Performing longer duration exercise routines with larger sample sizes would improve these results and could provide further evidence for or against the validity of this treatment. If further research supports the effectiveness of resistance training, it would then be beneficial to

compare this to non-exercise based treatments such as medications or surgery. Studies using PET and MRI technology to exam basal ganglia reaction to strength and resistance training would also be useful in proving treatment effect on brain physiology as well as motor function.

## References

1. Nutt JG, Wooten GF. Diagnosis and initial management of parkinson's disease. *N Engl J Med*. 2005;353(10):1021-1027. <http://dx.doi.org.ezproxy.pcom.edu:2048/10.1056/NEJMcp043908>. doi: 10.1056/NEJMcp043908.
2. Spraker MB, Yu H, Corcos DM, Vaillancourt DE. Role of individual basal ganglia nuclei in force amplitude generation. *J Neurophysiol* 2007;98:821–834
3. Kowal SL, Dall TM, Chakrabarti R, Storm MV, Jain A. The current and projected economic burden of parkinson's disease in the united states. *Movement Disorders*. 2013;28(3):311-318. doi: 10.1002/mds.25292.
4. Tarsey D. Treatment of parkinson disease: A 64-year-old man with motor complications of advanced parkinson disease. *JAMA*. 2012;307(21):2305-2314.
5. Corcos DM, Robichaud JA, David FJ, et al. A two-year randomized controlled trial of progressive resistance exercise for parkinson's disease. *Movement Disorders*. 2013;28(9):1230-1240. doi: 10.1002/mds.25380.
6. Paul, Serene SCanning, Colleen GSong, JoeunFung, Victor S.C.Sherrington, Catherine. Leg muscle power is enhanced by training in people with Parkinson's disease: A randomized controlled trial. *Clin Rehabil*. 2014;28(3):275-288. <http://ezproxy.pcom.edu:2048/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=pbh&AN=94517309&site=ehost-live&scope=site>. doi: 10.1177/0269215513507462.

7. Shulman LM, Katzel LI, Ivey FM, et al. Randomized clinical trial of 3 types of physical exercise for patients with parkinson disease. *JAMA Neurology*. 2013;70(2):183-190. <http://ezproxy.pcom.edu:2048/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=psyh&AN=2013-05825-006&site=eds-live&scope=site>. doi: 10.1001/jamaneurol.2013.646.

8. Park A, Zid D, Russell J, et al. Effects of a formal exercise program on parkinson's disease: A pilot study using a delayed start design. *Parkinsonism Relat Disord*. 2014;20(1):106-111. doi: <http://dx.doi.org.ezproxy.pcom.edu:2048/10.1016/j.parkreldis.2013.10.003>.