

BIOGRAPHICAL SKETCH

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NAME: **Daniel M. Corcos**

eRA COMMONS USER NAME (credential, e.g., agency login): **dcorcos**

POSITION TITLE: **Professor of Physical Therapy & Human Movement Sciences**

EDUCATION/TRAINING (*Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.*)

INSTITUTION AND LOCATION	DEGREE (if applicable)	Completion Date MM/YYYY	FIELD OF STUDY
University of Exeter, England	B.Ed.	06/1977	Education
University of Oregon, Eugene	M.A.	06/1980	Psychology
University of Oregon, Eugene	Ph.D.	06/1982	Motor Control
Rush University Medical Center, Chicago	Postdoc	07/1985	Motor Control

A. Personal Statement

It gives me great pleasure to be the PI of this phase III clinical trial on the efficacy of endurance exercise for delaying disease progression in Parkinson's disease. I am delighted to work with the key members of the same steering committee who oversaw the successful completion of the SPARX clinical trial of which I was co-PI. They are Drs. Delitto, Kohrt, Schenkman, and Patterson. In addition, we have added Drs. Cahane, Comella and Simuni to our steering committee. I am a neuroscientist with an interest in mechanistically driven therapeutic interventions for diseases such as Parkinson's disease that compromise movement, physical function and cognition. My colleagues and I have just successfully completed the SPARX study. We compared the effects of endurance exercise at 60-65% maximal heart rate versus 80-85% maximal heart rate. We showed that people with PD can exercise safely for a 6 month time period at 80-85% maximal heart rate and that disease progression was slowed at this dose. The SPARX study was a successful phase II multicenter exploratory trial that showed that a phase III clinical trial across a large number of sites is warranted. This study was published in *JAMA Neurology* in 2018. The results have been disseminated by 55 news outlets around the world and have been most favorably received by patient support groups in Michigan and Louisiana where I have been invited to speak.

I have also conducted the longest, randomized exercise clinical trial in Parkinson's disease that showed the efficacy of progressive resistance training for people with PD. This study received worldwide publicity in papers such as the Daily Telegraph in England, the Chicago Tribune, and several other publications such as Medpage and Internal Medicine News whose readership is physicians and the general public. Our paper on the effects of progressive resistance exercise on cognition was voted as the best research article published in *Movement Disorders* in 2015. As a result of my studies on exercise, I have been asked to contribute to the next edition of the ACSM Guidelines for Exercise Testing and Prescription (GETP, 11th edition).

I have published my clinical research in leading clinical journals including the New England Journal of Medicine, Lancet, JAMA Neurology, Annals of Neurology, Brain, Neurology, and Movement Disorders. I have also successfully renewed an NIH grant four times, an NIH grant on deep brain stimulation three times as well as having 2 other R01s and a U01. NIH has continuously funded my research since 1986. My colleagues and I have assembled an impressive team of movement disorders specialists and exercise physiologists who are leaders in their respective fields across 28 sites. I am very much looking forward to working with my colleagues on this research project whose results will the quality of life of people with PD.

Of the ~ 200 papers I have published, those that best illustrate my contribution to the importance of exercise are:

- Schenkman M, Moore CG, Kohrt WM, Hall DA, Delitto A, Comella CL, Josbeno DA, Christiansen CL, Berman BD, Kluger BM, Melanson EL, Jain S, Robichaud JA, Poon C, **Corcos DM**. Effect of High-

- Intensity Treadmill Exercise on Motor Symptoms in Patients With De Novo Parkinson Disease: A Phase 2 Randomized Clinical Trial. *JAMA Neurol.* 2018;75(2):219-26. PMID: 29228079; PMCID: PMC5838616.
- b. David FJ, Robichaud JA, Leurgans SE, Poon C, Kohrt WM, Goldman JG, Comella CL, Vaillancourt DE, **Corcos DM**. Exercise improves cognition in Parkinson's disease: The PRET-PD randomized, clinical trial. *Mov Disord.* 2015;30(12):1657-63. PMID: 26148003; PMCID: PMC4609235.
 - c. Lamotte G, Rafferty MR, Prodoehl J, Kohrt WM, Comella CL, Simuni T, **Corcos DM**. Effects of endurance exercise training on the motor and non-motor features of Parkinson's disease: A review. *J Parkinsons Dis.* 2015;5(3):621-5. PubMed PMID: 26406143.
 - d. **Corcos DM**, Robichaud JA, David FJ, Leurgans SE, Vaillancourt DE, Poon C, Rafferty MR, Kohrt WM, Comella CL. A two-year randomized controlled trial of progressive resistance exercise for Parkinson's disease. *Mov Disord.* 2013;28(9):1230-40. PMID: 23536417; PMCID: PMC3701730.

B. Positions and Honors

Positions and Employment

1985-1987	Assistant Professor , Department of Neurosurgery, Rush Medical Center, Chicago
1987-1993	Assistant Professor , Department of Physical Education, University of Illinois at Chicago
1993-1997	Associate Professor , School of Kinesiology, University of Illinois at Chicago
1997-2014	Professor , Department of Kinesiology, University of Illinois at Chicago
2014-	Professor , Physical Therapy & Human Movement Sciences, Northwestern University

Other Experience and Professional Memberships

1981-	Member, Society for Neuroscience
1994-	Neural Control of Movement
1996-1999	Ad hoc member. NIH Study Section – Geriatrics and Rehabilitation Medicine
2000-2003	Permanent member: NIH Study Section-Geriatrics and Rehabilitation Medicine
2003-2004	Member: F10 (29L): Minority/Disability F31S: Physiology and Pathology
2003-2006	Chair: NIH Study Section - Musculoskeletal and Rehabilitation Sciences
2007-2008	Ad-hoc member: Musculoskeletal and Rehabilitation Sciences Study Section
2008	Ad-hoc member: Motor Function, Speech and Rehabilitation Study Section
2009	Distinguished Editorial Panel member, NIH Challenge Grant Review
2009-2013	Permanent member: NIH Study Section: Motor Function, Speech and Rehabilitation
2010	Chair: Medical Rehabilitation Research Resource (R24) Special Emphasis Panel
2011-2013	Chair: NIH Study Section: Motor Function, Speech and Rehabilitation
2013	Core Member: NINDS INSPIRE Workshop
2014	Ad-hoc member: VA Review Panel, March
2014	Chair: SEP 2015/01 ZRG1 BDCN-R (02) Imaging Correlates of Neurodegeneration
2015	Ad hoc member NINDS G81/NSD-K Special Emphasis Panel for Clinical Trials
2015	ZNS1 SRB-J (09) NINDS SEP for Udall Applications
2016	Ad-hoc member: Motor Function, Speech and Rehabilitation Study Section
2016	Invited speaker NIH NCMRR/REACT Clinical Trials Workshop September 27 and 28.
2016	Ad hoc member NINDS NSD-K SEP for Clinical Trials (July and December)
2017	Ad hoc member NINDS NSD-K SEP for Clinical Trials (March)
2018	Ad hoc member NINDS ZNS1 SRB SEP for Clinical Trial Sites (NeuroNEXT) (March 2018)
2018	Ad hoc member NINDS ZNS1 SRB-A(18) for Clinical Trial Readiness for Rare Neurological and Neuromuscular Diseases (July 2018)

Honors

1986	NIH New Investigator Research Award
1986-1991	NIH FIRST Award
1992-1997	NIH Research Career Development Award
2001	Elected Member 426: National Academy of Kinesiology
2006	The Excalibur Award for Teaching Excellence (UIC College of Applied Health Sciences)
2008	Professor of the Year (UIC College of Applied Health Sciences)
2013	Platform Presentation AAPM&R, San Diego
2015	Illinois Physical Therapy Association's John Maselter Friend of Physical Therapy Award

- 2016 "Exercise improves cognition in Parkinson's disease: The PRET-PD randomized, clinical trial." Best research article published in Movement Disorders in 2015.
- 2016 Two Platform Presentations on Exercise in Parkinson's disease, ACRM, Chicago
- 2017 Hilton Endowed Lecture at Iowa State University: "Exercise and the Brain", January.
- 2017 Symposium 2017 Annual Meeting, World Congress on Exercise is Medicine®, and World Congress on The Basic Science of Exercise and the Brain in Denver, Colorado
- 2017 Chair and speaker, 2017 Movement Disorders Society 21st International Congress Symposium
- 2018 Honorary Member of the American Physical Therapy Association

C. Contribution to Science

1. **Endurance Exercise as a Therapeutic Intervention: (The SPARX study)** We have just successfully completed a phase II clinical trial in which we recruited 128 patients across 3 different sites with Parkinson's disease who have never been medicated (the SPARX study). The protocol for this study was published in 2013. We had the results of our Phase II clinical trial published in 2018. This study has allowed us to explore many of the key design aspects and variables that have informed the design of our phase III clinical trial. Most importantly, it suggested that exercising at 80-85% of maximal heart rate can slow down progression. Participants in this group increased disease progression by .3 points on the motor section of the UPDRS. Those who did not exercise increased by 3.2 points. We have also published a review article on the beneficial effects of endurance exercise for Parkinson's disease. This review summarizes the results of several studies and makes the case that to date no studies of endurance exercise prior to the SPARX study have shown a difference between two groups in the UPDRS.
 - a) Moore CG, Schenkman M, Kohrt WM, Delitto A, Hall DA, **Corcos D**. Study in Parkinson disease of exercise (SPARX): translating high-intensity exercise from animals to humans. *Contemp Clin Trials*. 2013;36(1):90-8. PMID: 23770108; PMCID: 3769494.
 - b) Lamotte G, Rafferty MR, Prodoehl J, Kohrt WM, Comella CL, Simuni T, **Corcos DM**. Effects of Endurance Exercise Training on The Motor and Non-Motor Features of Parkinson's Disease: A Review. *J Parkinsons Dis*. 2015;5(3):621-5. PubMed PMID: 26406143.
 - c) Schenkman M, Moore CG, Kohrt WM, Hall DA, Delitto A, Comella CL, Josbeno DA, Christiansen CL, Berman BD, Kluger BM, Melanson EL, Jain S, Robichaud JA, Poon C, **Corcos DM**. Effect of High-Intensity Treadmill Exercise on Motor Symptoms in Patients With De Novo Parkinson Disease: A Phase 2 Randomized Clinical Trial. *JAMA Neurol*. 2018;75(2):219-26. PMID: 29228079; PMCID: PMC5838616.

2. **Muscle Weakness and Parkinson's Disease:** From 1994 to 1995, I spent a year at the Institute of Neurology in London at the invitation of Professor C.D. Marsden and John Rothwell. I spent the year immersing myself in the study of Parkinson's disease. I published 4 articles showing that people with Parkinson's disease are weak, this weakness is linked to action tremor, and that weakness is reduced by levodopa. These studies form the basis of my clinical trial of the effects of progressive resistance training on reducing the symptoms of Parkinson's disease (see sections 4 and 5).
 - a) **Corcos DM**, Chen CM, Quinn NP, McAuley J, Rothwell JC. Strength in Parkinson's disease: relationship to rate of force generation and clinical status. *Ann Neurol*. 1996;39(1):79-88. PMID: 8572671.
 - b) Brown P, **Corcos DM**, Rothwell JC. Does parkinsonian action tremor contribute to muscle weakness in Parkinson's disease? *Brain*. 1997;120 (Pt 3):401-8. PMID: 9126052.
 - c) Brown P, **Corcos DM**, Rothwell JC. Action tremor and weakness in Parkinson's disease: a study of the elbow extensors. *Mov Disord*. 1998;13(1):56-60. PMID: 9452327.
 - d) McAuley JH, **Corcos DM**, Rothwell JC, Quinn NP, Marsden CD. Levodopa reversible loss of the Piper frequency oscillation component in Parkinson's disease. *J Neurol Neurosurg Psychiatry*. 2001;70(4):471-6. PMID: 11254769; PMCID: PMC1737290.

3. **Progressive Resistance Exercise and Parkinson's Disease: (The PRET study)** I have completed one successful clinical trial that has provided class II evidence that progressive resistance exercise is therapeutically beneficial of people with Parkinson's disease. We have 5 publications so far. Four are listed below. We have shown the progressive resistance exercise reduces the signs of PD, improves muscle strength and movement speed. We have also shown that exercise in general improves cognition, physical function and gait. It also restores some of the properties of the triphasic EMG pattern.

- a) **Corcos DM**, Robichaud JA, David FJ, Leurgans SE, Vaillancourt DE, Poon C, Rafferty MR, Kohrt WM, Comella CL. A two-year randomized controlled trial of progressive resistance exercise for Parkinson's disease. *Mov Disord*. 2013;28(9):1230-40. PMID: 23536417; PMCID: PMC3701730.
 - b) David FJ, Robichaud JA, Leurgans SE, Poon C, Kohrt WM, Goldman JG, Comella CL, Vaillancourt DE, **Corcos DM**. Exercise improves cognition in Parkinson's disease: The PRET-PD randomized, clinical trial. *Mov Disord*. 2015;30(12):1657-63. PMID: 26148003; PMCID: PMC4609235.
 - c) Prodoehl J, Rafferty MR, David FJ, Poon C, Vaillancourt DE, Comella CL, Leurgans SE, Kohrt WM, **Corcos DM**, Robichaud JA. Two-year exercise program improves physical function in Parkinson's disease: the PRET-PD randomized clinical trial. *Neurorehabil Neural Repair*. 2015;29(2):112-22. PMID: 24961994; PMCID: PMC4276552.
 - d) David FJ, Robichaud JA, Vaillancourt DE, Poon C, Kohrt WM, Comella CL, **Corcos DM**. Progressive resistance exercise restores some properties of the triphasic EMG pattern and improves bradykinesia: the PRET-PD randomized clinical trial. *J Neurophysiol*. 2016;116(5):2298-311. PubMed PMID: 27582297; PMCID: PMC5110637.
- 4) **Resistance Training With Instability: (The RTIS study)** I have published five papers on the effects of progressive resistance exercise training in combination with performing these exercises in an unstable environment. Four publications are listed below. These studies show that resistance training plus instability: a) reduces disease severity as measured by the Unified Parkinson's Disease Rating Scale and improves cognition, b) improves impaired spinal inhibitory mechanisms, c) increases quadriceps muscle cross-sectional area, increases root mean square and mean spike frequency of electromyographic signal, increases peak torque, rate of torque development of the knee extensors and plantarflexors during maximum ballistic voluntary isometric contractions, and d) improves balance and reduces fear of falling.
- a) Silva-Batista C, **Corcos DM**, Roschel H, Kanegusuku H, Gobbi LT, Piemonte ME, Mattos EC, MT DEM, Forjaz CL, Tricoli V, Ugrinowitsch C. Resistance training with instability for patients with Parkinson's disease. *Med Sci Sports Exerc*. 2016;48(9):1678-87. PubMed PMID: 27054681.
 - b) Silva-Batista C, Mattos EC, **Corcos DM**, Wilson JM, Heckman CJ, Kanegusuku H, Piemonte ME, Tulio de Mello M, Forjaz C, Roschel H, Tricoli V, Ugrinowitsch C. Resistance training with instability is more effective than resistance training in improving spinal inhibitory mechanisms in Parkinson's disease. *J Appl Physiol* (1985). 2017;122(1):1-10. PubMed PMID: 27834670.
 - c) Silva-Batista C, **Corcos DM**, Barroso R, David FJ, Kanegusuku H, Forjaz C, MT DEM, Roschel H, Tricoli V, Ugrinowitsch C. Instability resistance training improves neuromuscular outcome in Parkinson's disease. *Med Sci Sports Exerc*. 2017;49(4):652-60. PubMed PMID: 27851668.
 - d) Silva-Batista C, **Corcos DM**, Kanegusuku H, Piemonte MEP, Gobbi LTB, de Lima-Pardini AC, de Mello MT, Forjaz CLM, Ugrinowitsch C. Balance and fear of falling in subjects with Parkinson's disease is improved after exercises with motor complexity. *Gait Posture*. 2018;61:90-7. PubMed PMID: 29310015.
5. **Other Exercise Studies and Reviews:** I have published 2 review papers on the effects of progressive resistance exercise training. Both review papers strongly support the beneficial effects of progressive resistance training on people with Parkinson's disease. I have also published one article that compares yoga with resistance training and shows the benefits of both yoga and strength training for people with Parkinson's disease.
- a) David FJ, Rafferty MR, Robichaud JA, Prodoehl J, Kohrt WM, Vaillancourt DE, **Corcos DM**. Progressive resistance exercise and Parkinson's disease: a review of potential mechanisms. *Parkinsons Dis*. 2012;2012:124527. PMID: 22191068; PMCID: PMC3236435.
 - b) Lamotte G, Skender E, Rafferty MR, David FJ, Sadowsky S, **Corcos DM**. Effects of progressive resistance exercise training on the motor and nonmotor features of Parkinson's disease: a review. *Kinesiology Review*. 2015;4:11-27.
 - c) Bega D, Stein J, Zadikoff C, Simuni T, Victorson D, Ring M, Jovanovic B, **Corcos DM**. Yoga Versus Resistance Training in Mild to Moderate Severity Parkinson's Disease: A 12-Week Pilot Study. *Yoga & Physical Therapy*. 2016;6(1). doi: 10.4172/2157-7595.1000222.

Complete List of Published Work:

<http://www.ncbi.nlm.nih.gov/sites/myncbi/daniel.corcos.3/bibliography/47748966/public/?sort=date&direction=descending>

D. Research Support

Ongoing Research Support

- 5R01NS092950-03 Corcos (PI) 07/01/2016-06/30/2021
NIH/NINDS
Effect of Unilateral and Bilateral STN Stimulation on Eye-Hand Coordination
This proposal compares unilateral and bilateral stimulation of the subthalamic nucleus in Parkinson's disease, and how this facilitates or impairs the coordination of eye hand movements depending on the cognitive requirements of the task.
Role: PI
- 1U01NS102038-01 Vaillancourt, Corcos (PIs) 09/01/2017-06/30/2020
NIH/NINDS – awarded to Univ. of Florida
Neuroimaging Biomarkers in Parkinsonism: Differentiating Subtypes and Tracking Disease Progression
This U01 application focuses on the connections between key brain regions in Parkinson's disease (PD), multiple system atrophy (MSA) and progressive supranuclear palsy (PSP). These connections will be used to develop biomarkers to differentiate diseases and track disease progression.
Role: MPI
- 5R01NS100937-02 Corcos (PI) 09/15/2017-06/30/2022
NIH/NINDS
Bilateral Priming Plus Task Specific Training for Severe Upper Limb Hemiparesis
The goal of this study is to test a bilateral motor priming technique, comparing two groups of randomly assigned participants receiving task specific training, that is cost-effective and has the potential to significantly change clinical practice.
Role: PI
- 5R01HD075777-05 Madhavan (PI) 01/10/2014-12/31/2018
NIH/NICHHD – awarded to University of Illinois at Chicago
Cortical Priming to Optimize Gait Rehabilitation Post Stroke
The objective of this study is to develop a novel therapeutic intervention that is based on understanding neural adaptations to enhance gait in stroke survivors.
Role: Co-Investigator
- 5R01DK110669-02 Kutch (PI) 02/01/2017-01/31/2021
NIH/NIDDK – awarded to University of Southern California (subaward)
Sensorimotor Impairments in Men with Chronic Prostatitis/Chronic Pelvic Pain Syndrome: Relationship of resting state brain activity to pelvic floor muscle activation
Pelvic floor muscles provide the support and control that is necessary for voluntary and involuntary movement. In this project, we will test the hypothesis that men with chronic pelvic pain have changes in resting brain function associated with changes in muscle control underlying the dysfunction in this disorder.
Role: Co-Investigator
- 2R25HD074546-07 Field-Fote, Segal (PIs) 04/01/2018-03/31/2023
NIH/NICHHD – awarded to Medical University of South Carolina
Intensive Rehabilitation Research Grant Writing Workshops in the United States
The major goal of this workshop on writing grants is to train the next generation of physicians and rehabilitation scientists to be competitive for NIH funding.
Role: Mentor to Junior Faculty
- 4K12HD055931-11 Mueller (PI) 09/15/2007-08/31/2022
NIH/NICHHD – awarded to Washington University
Multicenter career development program for physical and occupational therapy
This proposal establishes a Multicenter Physical Therapy and Occupational Therapy Career Development Program (PT/OT CDP) designed to provide new investigators with the skills needed to lead research programs that validate rehabilitation approaches.
Role: Mentor to Junior Faculty