Exercise as Medicine
Essentials for Parkinson Disease
The WHY and HOW!

Becky Farley, PT, MS, PHD
CEO/Founder
Parkinson Wellness Recovery
becky@pwr4life.org
Cutting Edge Research in Exercise and Neuroplasticity ~the motivation~

Exercise is a physiological tool that promotes brain health, repair, adaptation, and behavioral recovery from the INSIDE.
A 501(c)(3) nonprofit founded in 2010 by Dr. Becky Farley

PWR! Vision
Communities where individuals with Parkinson disease have access to "Exercise as Medicine"

PWR! Mission
To provide individuals with Parkinson disease access to physiological tools that hold promise to slow disease progression, put off motor deterioration, improve symptoms, and increase quality of life.
Model Community Neurofitness and Wellness Center for Individuals with Parkinson disease Tucson, AZ

Implementing “Exercise as Medicine”

Specialized in research-based neuroplasticity principled rehab, fitness and wellness all in one facility.
Validating Model with Research

Do people get better and stay better with research-based protocols in a real world setting?
All stages of disease severity;
Group Classes PLUS 1:1 Physical Therapy

A Model Community Neurofitness and Wellness Center for People with Parkinson Disease.
PWR!Gym 1-year group pilot data.

1Becky Farley; 1Emily Borchers; 2Tara McIsaac; 1Amy Casady; 1Alexis Okurily; 1Jennifer Bazan-Wigle
1Parkinson Wellness Recovery, Tucson, AZ; 2A.T. Still University, Mesa, AZ

The effects of progressive aerobics and functional, amplitude-focused whole body training (PWR!Moves®) in an individual with advanced PD through an integrated physical therapy and PD-specific community exercise program - a case study

1Jennifer Bazan-Wigle; 1Kevin Moynahan; 1Emily Borchers; 1Becky Farley
1Parkinson Wellness Recovery, Tucson, AZ
CURRENT PARADIGMS

referrals are reduced, infrequent, late

**Improve function**

Exercise/Therapy

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>DX</td>
<td></td>
<td>Disease severity – H&amp;Y</td>
<td></td>
<td>End Stage</td>
</tr>
</tbody>
</table>

Loss of postural stability

63% Physical Therapy; 14% Speech Therapy; 9% Occupational Therapy

Barriers to Referral

- Perceived benefit by physicians
- Lack of awareness of supportive data
- Lack of clear indications for non-pharmacological care (nor time to screen for those referrals)

Evidenced Based Resources


- European Federation of Neurological Societies and Movement Disorder Society (EFS/MDS)
- National Institute for Health and Clinical Excellence (NICE)
- American Academy of Neurology (AAN)
- Movement Disorder Society (MDS)
- Cochrane Reviews
- Other Systematic Reviews
Indications/Physical Therapy

- Transfers
- Mobility
- Gait
- Physical Capacity
- Postural Instability/Balance
- Falls and fear of falling
- Freezing

Multiple Level 2-3-4 studies

Josefa Domingos, Miguel Coelho, Joaquim J Ferreira
Arq neuropsiquiatr 2013;71(12):967-972
Legitimate Therapeutic Options TODAY

To provide symptomatic relief and improved function, balance, gait, strength, physical capacity, fall risk

Academy of Neurology Practice Guidelines – 2006; 2010

![Diagram showing Medication, Deep Brain Stimulation, and Exercise/Rehab as overlapping circles]
Indications/Other

• Speech Therapy for Intensity, phonation, dysphagia
• PD Nurse for Counseling and Pallitative Care
• Insufficient
  – Occupational Therapy
  – Complementary Therapies
  – Non Motor
  – Advanced/Early Disease
  – Cognitive Impairment
  – Parkinsonism
  – Motor Complication

www.parkinsonnet.info/euguideline
New Indications for Brain Health, Brain Repair, and Function in PWP

Neuroprotection
Optimize Brain Health

Aerobic Training
- Start at DX
- Progressive effort beyond self-selected
- Continuous threshold

Neuroplasticity
Optimize Brain Repair and Adaptation

PD-specific Skill Acquisition
- Large amplitude bigger/faster functional movement training
- Multi-modal Approach
- Learning principled practice

Optimize Physical Capacity

Prevent Inactivity
- Educate/Empower/Coach
- Promote everyday activity and lifestyle
- Address non-motor barriers
- Optimize Medications
- Nutrition

www.parkinsonnet.info/euguideline
EXERCISE AS MEDICINE for Parkinson Disease??

INDICATIONS

ESSENTIALS

DOSAGE

BARRIERS
Brain changes identified vary with disease severity

- **Preclinical Phase**: Neuroprotection
- **Early/Moderate Phase**: Neurorepair
- **Late Phase**: Adaptation
Bottom LINE:
Exercise optimizes brain health and efficiency

1. **Preclinical**
   - Protects/rescues vulnerable neurons
     - Sustains/increases DA function

2. **Early/Moderate**
   - Enhances recovery or recruitment of damaged circuits
     - DA shunted to active circuits, where needed
     - Noisy glutamate circuits are normalized, improved signal to noise
     - DA receptors upregulated

3. **Advanced**
   - Undamaged areas recruited

Do more with less!
Evidence for Neuroprotection in People with PD: Epidemiological, Anecdotal & Experimental

- Regular, moderate to vigorous exercise in midlife—lowers risk for developing PD.
- Exercise increases survival rate.
- Higher cognitive scores associated with greater physical fitness
- Regular exercise reduces the severity of motor/non-motor symptoms and improves function with 3-6 month retention.

Randomized Controlled Trial of Community-Based Dancing to Modify Disease Progression in Parkinson Disease

Ryan P. Duncan, MPT¹ and Gammon M. Earhart, PhD¹

Neurorehab Neural Repair
2012;26(2):132-143
Exercise and Brain Changes in People with Early PD

Progressive Treadmill Training
50’, 3x/week; 6 weeks
75-85%

Multidisciplinary Intensive Rehabilitation Training
3 hours/day; 5 days/week; 4 weeks

Intensive Rehabilitation Enhances Lymphocyte BDNF-TrkB Signaling in Patients With Parkinson’s Disease

Cecilia Fontanesi, MS/MPhil1,2, Svetlana Kvint1, Giuseppe Frazzitta, MD3, Rossana Bera3, Davide Ferrazzoli, MD3, Alessandro Di Rocco, MD4, Heike Rebholz, PhD3, Eltan Friedman, PhD3, Gianni Pezzoli, MD5, Angelo Quartarone, MD3,4, Hoau-Yan Wang, PhD3, and M. Felice Ghilardi, MD1,4

Treadmill Training (Fisher et al. 2013; Fisher et al. 2004; 2008; Petzinger et al. 2007; Vuckovic et al. 2010;)
Fontanesi, et al. 2015

Noisy circuits are silenced.

MORE DA Receptors.

Triggers Protective Factors
EXERCISE AS MEDICINE

INDICATIONS

ESSENTIALS

DOSAGE

BARRIERS
Exercise interventions in individuals with Parkinson’s disease incorporate goal-based motor skill training to engage cognitive circuitry important in motor learning. With this exercise approach, physical therapy helps with learning through instruction and feedback (reinforcement) and encouragement to perform beyond self-perceived capability.
Ongoing vigorous exercise and physical fitness should be central place in our treatment of PD and highly encouraged. Conclusion!

PD physical therapy programs should include structured, graduated fitness instruction and guidance for deconditioned patients with PD. Conclusion!

Levodopa and other forms of dopamine therapy should be used to achieve maximum capability and motivation for patients to maintain fitness! Conclusion!
Potential motor/nonmotor targets of aerobic exercise!

Speelman, AD et al. Nature Reviews Clinical Neurology 7, 528-534 (September 2011)

- Prevention of cardiovascular complications
- Arrest of osteoporosis
- Improved cognitive function
- Prevention of depression
- Improved sleep
- Decreased constipation
- Decreased fatigue
- Improved functional motor performance
- Improved drug efficacy
- Optimization of the dopaminergic system

Exercise benefits multiple systems
The Therapeutic Potential of Exercise to Improve Mood, Cognition, and Sleep in Parkinson’s Disease

Gretchen O. Reynolds, MA,¹ Michael W. Otto, PhD,¹ Terry D. Ellis, PhD,² and Alice Cronin-Golomb, PhD¹*

Engaging Cognitive Circuits to Promote Motor Recovery in Degenerative Disorders. Exercise as a Learning Modality

by

Michael W. Jakowec¹, Zhou Wang², Daniel Holschneider², Jeff Beeler³,
Giselle M. Petzinger¹

Enhancing Neuroplasticity in the Basal Ganglia: The Role of Exercise in Parkinson’s Disease

Giselle M. Petzinger, MD,¹,²* Beth E. Fisher, PhD,² Jon-Eric Van Leeuwen, BSc,¹ Marta Vukovic, MSc,¹
Garnik Akopian, MD,³ Charlie K. Meshul, PhD,⁴ Daniel P. Holschneider, MD,⁵ Angelo Nacca, PhD,⁶
John P. Walsh, PhD,³ and Michael W. Jakowec, PhD¹,²
Cortical and motor responses to acute forced exercise in Parkinson’s disease.
How you Practice is Important!
Learning Principles

- Attentional Focus
- Emotional Engagement
- Cognitive Engagement
- Physical Effort

- Challenge attention, self-monitoring
- Salient, Fun, rewarding
- Real World Dual Tasks Boosts!
- Drive motor output
  Multiple systems
  breathe, hands, voice, eyes
Motor Learning in PD?

Research Report

Evidence for motor learning in Parkinson’s disease: Acquisition, automaticity and retention of cued gait performance after training with external rhythmical cues

Lynn Rochester\textsuperscript{a,b,*}, Katherine Baker\textsuperscript{b}, Victoria Hetherington\textsuperscript{b}, Diana Jones\textsuperscript{b}, Anne-Marie Willems\textsuperscript{c}, Gert Kwakkel\textsuperscript{d}, Erwin Van Wegen\textsuperscript{d}, Inge Lim\textsuperscript{d}, Alice Nieuwboer\textsuperscript{c}

Motor learning in Parkinson’s disease: limitations and potential for rehabilitation

Alice Nieuwboer\textsuperscript{a,*}, Lynn Rochester\textsuperscript{b}, Liesbeth Müncks\textsuperscript{a}, Stephan P. Swinnen\textsuperscript{c}
Multidimensional Balance Training outdoors

Dynamic Balance while Walking

Slope & stairs

Biomechanics

Adding complexity with context-specific approach

Limits of Stability

Preparatory Posture Prior to Stepping

Soft/uneven ground/obstacles

POSTURAL CONTROL

DG  BC  LOS  SI  APA  PR

Sensory Integration

Balance Response

Cognitive-motor fall prevention training
If WHAT and HOW you practice is important! Let’s make it PD-specific.

PD-Specific **Skill Acquisition**

**Mechanism:**
Enhance Circuitry;
Challenge Dopamine Circuits

**Use it and Improve it!**
PD-Specific Skill Training

• Target **skills** that become impaired in PWP!

<table>
<thead>
<tr>
<th>SKILL</th>
<th>Basic4</th>
<th>PWR! Moves</th>
</tr>
</thead>
<tbody>
<tr>
<td>– Antigravity extension</td>
<td></td>
<td>PWR! UP</td>
</tr>
<tr>
<td>– Weight shifting</td>
<td></td>
<td>PWR! ROCK</td>
</tr>
<tr>
<td>– Axial mobility</td>
<td></td>
<td>PWR! TWIST</td>
</tr>
<tr>
<td>– Transitions</td>
<td></td>
<td>PWR! STEP</td>
</tr>
</tbody>
</table>

• Amplitude-focused whole body movements

• Functionally based
**Why Amplitude-Focused**

*PD-Specific Target – Bradykinesia*

Dopamine loss/disease progression correlates most strongly with severity of bradykinesia.

**Speed/amplitude dysregulation problem**

Big movements are slow; Fast movements are small

Scaling amplitude/speed requires the greatest amount of acceleration/power!

**Why Whole Body Focused**

Bradykinesia occurs across motor control systems! (fine motor, respiration, walking, speech, postural control)
Intensive Amplitude-specific Therapeutic Approaches for Parkinson’s Disease Toward a Neuroplasticity-principled Rehabilitation Model

Becky G. Farley, PT, PhD; Cynthia M. Fox, PhD, CCC-SLP; Lorraine O. Ramig, PhD, CCC-SLP; David H. McFarland, PhD, SLP

Accepted Manuscript

Impact of physical exercise on reaction time in patients with Parkinson’s disease – Data from the Berlin BIG study

G. Ebersbach, M.D. Almut Ebersbach, M.D. Florin Gandor, M.D. Brigitte Wegner, Jörg Wissel, M.D. Andreas Kupsch, M.D.
ORIGINAL RESEARCH

Comparative Effect of Power Training and High-Speed Yoga on Motor Function in Older Patients With Parkinson Disease

Meng Ni, PhD, a Joseph F. Signorile, PhD, a,b Kiersten Mooney, MS, c Anoop Balachandran, MS, a Melanie Potiaumpai, MS, a Corneliu Luca, MD, PhD, d James G. Moore, PT, PhD, e Christopher M. Kuenze, PhD, a Moataz Eltoukhy, PhD, a Arlette C. Perry, PhD a

From the aLaboratory of Neuromuscular Research and Active Aging, University of Miami, Coral Gables, FL; bCenter on Aging, University of Miami School of Medicine, Miami, FL; cGreen Monkey Yoga, Miami, FL; and Departments of dNeurology and ePhysical Therapy, University of Miami, Coral Gables, FL.

Adaptive training with full-body movements to reduce bradykinesia in persons with Parkinson’s disease: a pilot study

Susanna Summa1*, Angelo Basteris1,2, Enrico Betti3 and Vittorio Sanguineti1
To optimize real world carryover. Better quality practice for better quality everyday movement.

Bradykinesia interferes most with habitual, (overlearned) everyday movements. Dressing, walking, in/out bed, sit to stand

GOAL: Habit formation and maintenance!!!
SO...train the skills they need for FUNction
Start with AMPLITUDE and Target Multiple Aspects of Function and Mobility

Amplitude Focused FUNctional Skill Training

- Lifestyle
- Agility/Transfers/Turning
- Aerobics
- Strength
- Flexibility
- Balance
- ADL/Function
- Reach/Grasp Activities
- Gait

Social, Sports, Hobbies, Recreation

Dance, Boxing
Endurance Activity
Yoga/Chi Qong
Tai Chi

PWR!
Parkinson Wellness Recovery
A Disease Specific Exercise Approach in Independent Community Dwellers with Parkinson’s Disease: A Pilot Study

Alexis M. Okurily, Emily White, Tarang K. Jain, Valerie A. Carter
Department of Physical Therapy and Athletic Training, Northern Arizona University, Flagstaff, AZ, USA

<table>
<thead>
<tr>
<th></th>
<th>General Exercise Group</th>
<th>Disease-Specific Exercise Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>19</td>
<td>13</td>
</tr>
<tr>
<td>Age (years)</td>
<td>64.7 ± 3.7</td>
<td>71.07 ± 8.2</td>
</tr>
<tr>
<td>Gender (M/F)</td>
<td>8/11</td>
<td>10/3</td>
</tr>
</tbody>
</table>

**Timed Up and Go**

**3-meter backward walk test (3MBWT)**

**Gait Speed**
EXERCISE AS MEDICINE

INDICATIONS

ESSENTIALS

DOSAGE

BARRIERS
INTENSITY
(Aerobics/Function)

- Vigorous/Forced Exercise is completed at 60-80% Heart Rate Max
- Exercise can also be measured on the “Rate of Perceived Exertion Scale”
  – Goal: 6-8/10

<table>
<thead>
<tr>
<th>RPE Scale</th>
<th>Rate of Perceived Exertion</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td><strong>Max Effort Activity</strong> Feels almost impossible to keep going. Completely out of breath, unable to talk. Cannot maintain for more than a very short time.</td>
</tr>
<tr>
<td>9</td>
<td><strong>Very Hard Activity</strong> Very difficult to maintain exercise intensity. Can barely breath and speak only a few words</td>
</tr>
<tr>
<td>7-8</td>
<td><strong>Vigorous Activity</strong> Borderline uncomfortable. Short of breath, can speak a sentence.</td>
</tr>
<tr>
<td>4-6</td>
<td><strong>Moderate Activity</strong> Breathing heavily, can hold short conversation. Still somewhat comfortable, but becoming noticeably more challenging.</td>
</tr>
<tr>
<td>2-3</td>
<td><strong>Light Activity</strong> Feels like you can maintain for hours. Easy to breathe and carry a conversation</td>
</tr>
<tr>
<td>1</td>
<td><strong>Very Light Activity</strong> Hardly any exertion, but more than sleeping, watching TV, etc</td>
</tr>
</tbody>
</table>

PWR! Parkinson Wellness Recovery
Evidence that annual intensive bouts of functional exercise may reduce the need for medication overtime in human PD.

Differences statistically different (p < 0.0001)

Effectiveness of Intensive Inpatient Rehabilitation Treatment on Disease Progression in Parkinsonian Patients: A Randomized Controlled Trial With 1-Year Follow-up.
Giuseppe Frazzitta, MD et al. Neurorehabi Neural Repair, Aug 15, 2011
Intensive Rehabilitation Treatment in Early Parkinson’s Disease: A Randomized Pilot Study With a 2-Year Follow-up

Giuseppe Frazzitta, MD\textsuperscript{1,2}, Roberto Maestri\textsuperscript{3}, Gabriella Bertotti\textsuperscript{3}, Giulio Riboldazzi, MD\textsuperscript{4}, Natalia Boveri\textsuperscript{5}, Michele Perini, MD\textsuperscript{5}, Davide Uccellini, MD\textsuperscript{6}, Marinella Turla, MD\textsuperscript{7}, Cristoforo Comi, MD\textsuperscript{8}, Gianni Pezzoli, MD\textsuperscript{9}, and M. Felice Ghilardi, MD\textsuperscript{10}

DOSAGE: 3 HOURS/DAY 5 DAYS/WEEK 4 WEEKS = 60 HOURS TOTAL

equivalent dosage. MIRT, multidisciplinary intensive rehabilitation treatment.

s in monotherapy with resagiline. MIRT, multidisciplinary intensive rehabilitation treatment.
FREQUENCY/DURATION

• **Goal Directed Training – Learning**
  – Intermittent “intensives – tune-ups” for life
  – 3-5 days/week; depends upon duration, disease severity
  – i.e., 4 weeks = 4-5 days/week, 6 months = 3 days per week

• **Progressive Aerobics**
  – Goal: 3x/week vigorous 30-45’; 3x/week low/moderate 45-60 minutes;
  – Minimum at a time: 10 minute bouts
FREQUENCY/DURATION

• Improvements have been shown to last 1-6 months
• Continuous exercise required to maintain benefits
  – Coaching/Maintenance
    • Less frequent to monitor, coach, update, coordinate community access, current needs
    • i.e., 1x/week or 1x/month or 3-month update program…..
  – Community group exercise programs
Legitimate Therapeutic Options

Exercise as Medicine

Exercise
How, When, What

Medication

Deep Brain Stimulation

Community:  Tango, Irish/Tango Dancing, Tai chi, Yoga, Qi Gong, Cycling, Boxing, Agility, Pole Walking

PD-Specific Functional Amplitude Training

Progressive Aerobics

Neuroplasticity Learning-principled

1:1 Intensive Physical Therapy

Multidisciplinary Rehab

NeuroProtection Brain Health
TIME FOR NEW PARADIGMS

Exercise is Medicine for Parkinson’s

**Improve function**

Exercise

1. Pre-motor symptomatic period
2. Disease severity – H&Y
3. Loss of postural stability
4. End Stage

**Slow motor deterioration**

Optimize brain health/brain function

1. Disease severity – H&Y
2. Loss of postural stability
Implications for Healthcare Delivery Paradigms

Start Exercise at Diagnosis & continue for life!

SIGNATURE

PWR! Parkinson Wellness Recovery
Collaborations/Networks

- PD specialized Therapist/Coach assess/reassess ~3-6 months
- Physician Optimize Medications
- 1:1 Intense rehab
- Community Centered Exercise and Wellness Facility
- Community Class Instructors

A Lifetime of Optimal Care
Empower & Educate – Give Control!
Show people what they CAN do!
Identify what they WANT to do!

Expectations/Placebo enhance (or reduce) learning in PD. Nature Neuroscience 2014
What aspect of living with PD is most challenging? Psychological barriers #1 issue to majority of PWP!

<table>
<thead>
<tr>
<th>Stigma</th>
<th>Social Support</th>
<th>Pain</th>
</tr>
</thead>
</table>

For many people, one issue stands out as the most challenging part of Parkinson’s. Over half the people in the study had one aspect of Parkinson’s that was much more troubling than the others. Everyone’s journey is different.
Inactivity and PD?

• Inactivity (forced non use OR STRESS)
  – worsens symptoms;
  – contributes to disease progression;
  – is PRO-degenerative

Forced Nonuse in Unilateral Parkinsonian Rats Exacerbates Injury

Jennifer L. Tillerson,¹ Ann D. Cohen,³ W. Michael Caudle,² Michael J. Zigmond,³ Timothy Schallert,¹,⁴ and Gary W. Miller¹,²

¹Institute for Neuroscience and ²Division of Pharmacology and Toxicology, College of Pharmacy, University of Texas at Austin, Austin, Texas 78712, ³Department of Neurology, University of Pittsburgh, Pittsburgh, Pennsylvania 15260, and ⁴Department of Neurosurgery, University of Michigan, Ann Arbor, Michigan 48109

The Journal of Neuroscience, August 1, 2002, 22(15):6790–6799
At DX, PWP are already below norms for HC. Begin EXERCISE/Physical Therapy AT DX!
Optimal medications + optimal exercise & lifestyle

Non Motor Symptoms

- Psychological symptoms (stigma/social network/self-efficacy)
- Emotional symptoms (apathy, anxiety, depression)
- Cognitive symptoms (Reduced awareness and ability to self monitor and correct)
- Autonomic symptoms (pain, sleep, blood pressure,....)
  - nutrition, counseling, complementary/alternative referrals, stress management, urologist/pelvic floor specialist

Comorbidities/Exercise HX/Logistics/Motivation
PD-Specific Movement Demo

- Functional Skills Targeted
  - High Effort
  - BIG/FAST Whole Body Movement (Bradykinesia/Rigidity)
  - Learning Principled (Progression) (Cognitive/Attentional Systems Challenged)
**PWR! Up Focus:** Posture/Alignment

**Why:** Counteract rigidity – stooped posture, weak extensors, spinal deformities. Reduce falls, freezing/hesitation. Improve gait and ability to step bigger.
PWR! Rock Focus: Weight Shifting

Why: Necessary to “get moving”, to turn, to roll, & retraining better balance and a wider base of support
**PWR! Twist Focus:** Trunk Rotation

**Why:** Reduces rigidity when practiced rhythmically. Necessary to “transition” body through space/postures.
**PWR! Step Focus:** Transition

**Why:** To move to a different location efficiently and effectively. To catch your balance, to strengthen muscles.
The END!

Questions?
becky@pwr4life.org
www.pwr4life.org