Physical Capacity & Activity

- Physical Capacity: What people are capable of
- Activity: What people actually do

- Inactivity leads to decreased physical capacity
  - People with Parkinson’s (PWP) are less active than their healthy peers.

Recommended Activity Levels

<table>
<thead>
<tr>
<th>Table 6.2: MDS recommendations for physical activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>In adults (18 to 64 years):</td>
</tr>
<tr>
<td>- Aerobic physical activity:</td>
</tr>
<tr>
<td>- on 5-7 days/week at moderate intensity</td>
</tr>
<tr>
<td>- on 3-5 days/week at vigorous intensity</td>
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<tr>
<td>- or an equivalent combination thereof</td>
</tr>
<tr>
<td>- The aerobic activity should be performed in bouts of at least 10 minutes duration</td>
</tr>
<tr>
<td>- Muscle-strengthening activities involving major muscle groups on 2 days/week</td>
</tr>
<tr>
<td>- For additional health benefits:</td>
</tr>
<tr>
<td>- 205 minutes of moderate-intensity aerobic physical activity / week</td>
</tr>
<tr>
<td>- or 156 minutes of vigorous-intensity aerobic physical activity / week</td>
</tr>
<tr>
<td>- or an equivalent combination thereof</td>
</tr>
</tbody>
</table>

In older age (≥65 years), equal to adults, but in addition:
- In case of poor mobility: physical activity to enhance balance and prevent falls on 2 days/week

- 10,000 steps & 30 minutes vigorous activity per day
  (American Heart and Cancer Associations)
Physical activity and the risk of Parkinson disease

- Further, strenuous exercise in early adult life was also inversely related to PD risk in men: compared with men who regularly exercised < 2 months/year, those with >10 months of strenuous exercise had a 60% lower PD risk.
- In women, physical activity assessed at baseline was not related to PD risk, whereas strenuous exercise in early adulthood tended to be inversely related to PD risk later in life.

**BOTTOM LINE:**
- Intensity of exercise is important
- Amount/frequency of exercise is important
- People with PD need to be educated on true requirements of exercise/physical therapy to improve/sustain improvements.

Chen et al, 2005

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Quantifying daily physical activity and determinants in sedentary patients with Parkinson’s disease


- Accelerometer data of 467 patients who fulfilled all criteria revealed the > 98% of their day was spent on sedentary to light-intensity activities.
- 82% of the participants were “physically inactive” (0 days/week of 30-min activity); 17% were “semi-active” (1-4 days/week of 30-min activity).

Donje et al 2013

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Changes in Ambulatory Activity in People with PD Over One Year

<table>
<thead>
<tr>
<th>Variable</th>
<th>Baseline Mean (95% confidence interval)</th>
<th>One year Mean (95% confidence interval)</th>
<th>Magnitude of change (%) (95% confidence interval)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>64.64 (64.05-65.24)</td>
<td>64.50 (63.94-65.06)</td>
<td>-0.14 (-0.28)</td>
</tr>
<tr>
<td>Years with PD</td>
<td>65.02 (64.44-65.60)</td>
<td>65.00 (64.40-65.60)</td>
<td>-0.02 (-0.08)</td>
</tr>
<tr>
<td>Hoehn and Yahr Stage (median)</td>
<td>1 (0-2)</td>
<td>1 (0-2)</td>
<td>-4 (0-10)</td>
</tr>
<tr>
<td>UPPD (mm)</td>
<td>192.40 (183.56-201.24)</td>
<td>192.40 (183.56-201.24)</td>
<td>0.00 (0.00)</td>
</tr>
<tr>
<td>Steps</td>
<td>12,793 (12,698-12,888)</td>
<td>12,793 (12,698-12,888)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Moderate intensity minutes</td>
<td>22.9 (22.4-23.4)</td>
<td>23.1 (22.6-23.6)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>MDS-UPDRS Motor subscore</td>
<td>28.18 (25.31-31.22)</td>
<td>28.52 (24.30-32.07)</td>
<td>-0.34 (-0.60)</td>
</tr>
<tr>
<td>MDS-UPDRS Total score (median)</td>
<td>1 (0-2)</td>
<td>1 (0-2)</td>
<td>-0 (0)</td>
</tr>
<tr>
<td>3-minute walk (seconds)</td>
<td>181.5 (176.4-186.6)</td>
<td>181.5 (176.4-186.6)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>MDS-UPDRS total (median)</td>
<td>2.74 (2.65-2.83)</td>
<td>2.74 (2.65-2.83)</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

Couturaud JT, Ellis T, Earhart GM et al. JWP2012-34:51
• Utilized the LAPAQ, a validated physical activity questionnaire.

• Multivariate regression analysis demonstrated that greater disease severity, gait impairment, and greater disability in daily living were associated with less daily physical activity.

• A portion of the variance remained unexplained, suggesting that additional determinants may also affect daily physical activities.

Van Nimwegen et al 2011

Animal Models of PD
Non-use Paradigms

Inactivity (or stress) may contribute to the disease process.

(Tillerson et al., 2001; 2002; 2003)
Results suggest decreased activity is not only a symptom of PD but also may act to potentiate the underlying degeneration

STOPPING exercise
OR
Adding STRESS
CANCELLED
the brain and behavioral benefits
GAINED BY EXERCISE!

Tilson et al 2002

Evidence other non motor factors potentiate the underlying degeneration

Combined Model of PD (neurotoxin) + Depression (chronic unpredictable stress)

Hemner, Dickerson, Herman & Seroogy (2014) Molecular Psychiatry (Vol 19)

Evidence in Humans for inactivity contributing to degeneration

- The patients were classified into three groups according to the degree of physical exercise performed, and the mortality ratios of each group were:
  - High exercise: 1.68
  - Intermediate: 2.90
  - Low: 2.75

- Regular exercise (even if exercise was passive in the case of more impaired individuals) was associated with decreased mortality.

Kuroda et al 1992
Factors Associated With Exercise Behavior in People With Parkinson Disease

Terry Ellis, James T. Cavanaugh, Camron M. Earhart, Matthew P. Ford, K. Be Foreman, Lisa Fredman, Jennifer K. Boudreau, Lotard E. stimulates

- Participants with high self-efficacy were more than twice as likely to engage in regular exercise than those with low self-efficacy.
- College educated and older participants also were more likely to exercise
- Factors from the body structure and function, participation and personal factor domains were significantly associated with engaging in regular exercise.

How to Measure Physical Capacity

- Six Minute walk test with Borg
- 5 Times Sit and Stand Test
- Other components of physical exam also very useful in determining more comprehensive aspects of physical capacity.

How to Measure Activity

- Questionnaires
  - LASA Physical Activity Questionnaire (LAPAQ)
- Activity Monitors
  - Apps in smartphones
  - Fitbit, LumoLift, etc.
- Consider ABC and cognitive screening for accuracy of self-assessment and ability to change habits
Medications must be optimized

- Clinicians must facilitate exercise by appropriate aggressive use of PD drugs. Over the last 2 decades, very conservative symptomatic medical treatment has often been advised, “saving” the best PD treatments for later and arbitrarily limited dosage.
- There is no compelling evidence that medication responses can be saved for years later, and similarly there is no good evidence that low doses convey some beneficial effect in the long term.
- Rather, this approach may translate into lost opportunities.
- A reasonable goal when prescribing PD medications is to maximize patients' capabilities to engage in physical activities and potentially achieve the best level of physical fitness possible.

Ahlskog JE Neurology 2011;77:299-294

What does it mean to improve Physical Capacity?

- Prevent Inactivity – Address readiness/barriers; self-efficacy
- Exercise – Aerobics and Conditioning
- Optimize brain health/circuitry • Neuroplasticity
- Neurprotection/Neurorepair/adaptation
- Benefits motor/psychological/non motor symptoms
- Prevent secondary complications (precursors to function)
- Endurance, muscle strength, joint mobility, balance

Potential motor/nonmotor targets of 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 performances
- Improved drug efficacy
- Optimization of the dopaminergic system
What does it mean to improve Physical Capacity?

- **Prevent Inactivity** – Address readiness/barriers; self-efficacy
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  - Benefits motor/psychological/non motor symptoms
  - Prevent secondary complications (precursors to function)
  - Endurance, muscle strength, joint mobility, balance
- **Exercise – Skill Acquisition/Function**
  - Focus on large/fast whole body functional task exercises
  - High effort, attention to action
  - PD-specific goals: rigidity; bradykinesia; incoordination
  - Apply Motor learning principles
    - Progressively increase difficulty/attention/complexity/specificity
    - Enhance quality of practice with cues/feedback/reward/imagery/modeling/strategies
- **Enhance Lifestyle** – Sustain/Revisit preferred activities

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**Goal based Functional Exercise + Aerobic exercise**

Work in synergy for optimal brain and behavioral benefits.

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**Animal Models of PD**

Demonstrate the physiological benefits of aerobics + goal oriented exercise to optimize brain health/brain repair and FUNCTION

- **Preclinical Phase** – Neuroprotection
- **Early/Moderate Phase** – Neurorepair
- **Late Phase** – Adaptation

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**Figure 3. Giselle M Petzinger, Beth E Fisher, Sarah McEwen, Jeff A Beeler, John P Walsh, Michael W Jakowec.**

Why is that important to human PD?

Slow disease progression Vs Slow motor deterioration/disability

- Does it spare or rescue or rejuvenate vulnerable DA neurons? NEUROPROTECTIVE
- Does it normalize (reorganize) abnormal neural circuity? NEUROREPAIR

Response to Exercise Evidence for Neurorepair/Adaptation

- Post-exercise
- Off-medication
- On-medication

- Greater Recruitment of DA system
- More DA Receptors

In human PD

- Fish et al., 2013; Fisher et al., 2004, 2008; Petzinger et al., 2007; Vuckovic et al., 2010; Alberts J et al., Exer Sport Sci Rev 2011

Progressive Aerobic Exercise More than Cardio??? Why??

- Treadmill; Cycling; Whole body agility
- Improves Motor Function in PWP:
  - Gait speed, stride, symptoms, balance, L/E/UE function, ease of movement
  - Ahlskog J. Neurology 2011;77:288-294
- Improves Cognitive/Emotional Function in PWP:
  - Improved language function
  - Improved executive function
  - Improves Mood/QoL

- Frenkel-Toledo; Pohl; Miyai; Caktiv; Herman; Kurtais; Fisher; Alberts
Evidence that annual intensive bouts of functional exercise may reduce the need for medication overtime in human PD (improve sleep, decrease dyskinesias). 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. Neurorehab Neural Repair Aug 15, 2011

PD-specific components for optimal brain and behavioral function. Progressive Aerobic + Amplitude Training

Neural Priming
- Metabolically prepares the neural substrates to "work" efficiently/fast
- Promotes brain health and brain/muscle interactions
- Turns on attentional/working memory systems
- Increases motor output

Learning
- Promotes structural restoration and reorganization.
- Underlies long term behavioral changes.
- Automaticity

Aerobic Training
- PD-specific Skill
- Includes structural restoration and reorganization.
- Underlies long term behavioral changes.
- Automaticity

PD-Specific Target – Bradykinesia
- Dopamine loss/disease progression correlate most strongly with severity of bradykinesia.
  - Speed/amplitude dyregulation
  - Big movements are slow; Fast movements are small
- Train the scaling of muscle activation for bigger and faster movements that require the greatest amount of acceleration/power.

Start at DX!
Use it or lose it./Use it and Improve it.
ACTIVATE

MOTOR OUTPUT

Target HIGH EFFORT for large amplitude whole body movements.

The training of amplitude is more than just increasing motor output!

Attention to Action

“how it feels” to perform optimal function

Teach self-monitoring

“what to pay attention to”

Require self-correction of small/slow movements.

ACTIVATE: OPTIMAL FUNCTION

Focused attention directed on the EFFORT required to:

To sustain an OPTIMAL posture, with the largest ROM possible,

Or

To perform an OPTIMAL movement, as BIG and FAST as possible.
Bradykinesia interferes most with habitual, (overlearned) everyday movements. Dressing, walking, in/out bed, sit to stand

Increase carryover and adaptability of amplitude-training across disease severity.

Make FUNction Exercise™ as a Foundation to a Comprehensive Exercise Program.

PWR!Moves
Amplitude Focused Functional Exercise
Building Blocks for FUNction

Basic 4 | PWR!Moves™

Functional Tasks/Activities
- Enrichment
- Sports
- Hobbies
- Work
- ADL
- Vocational

- Rolling Over
- Stand to Peer
- Reach & Snap
- Walk to Sit
- Stand & Reach
- Sit to Stand

© 2014 NeuroFit NetWorks I Parkinson Wellness Recovery
Target PD-Specific Symptoms

- **Rigidity** – reduced spinal flexibility and posture (PREPARE)
  - High effort for large amplitude sustained active stretch and awareness
- **Bradykinesia** – slow/small everyday movement (ACTIVATE)
  - High effort for large amplitude repetitive whole body movements
- **Incoordination/Balance (FLOW)**
  - Link movement/action sequences (Agility)
- **Cognition/Attention (BOOSTERS)**
  - Building complexity and attentional focus
- **Emotion**
  - Reward-based feedback
  - Saliency/MakE FUNction Exercise!!
  - Empowerment
Bradykinesia is generalized across motor systems (speech, reaching, gait, fine-motor, respiration) – so integrate amplitude training across multiple systems, involving voice/speaking, hands, breathing, eyes.

Train attention for common everyday dual tasks. Build real world complexity.

PWR! BOOSTS
Amplitude-focused functional exercise training can be instructed across disciplines, settings, tasks, function, ADL, lifestyle, and be integrated into any research-based approach (treadmill, cueing, pole walking, turning, agility, spinal flexibility, etc).
Make FUNction Exercise. Target Multiple Aspects of Function and Mobility

Amplitude Focused FUNCTIONal Training
PWR!Moves

Endurance Activity

Yoga/Chi Qong

Social, Sports, Hobbies, Recreation

Agility/Transfers/Turning

Endurance Activity

Reach/Grasp Activities

ADL/Funtion

Balance, Tai Chi

Lifestyle

Strength

Gait

Flexibility

Aerobics

Time for new Paradigms!!!

THE END!

Neuroplasticity, Principle

Early Intervention

Intensive, Bouts for LIFE!

Forced Use

Continuous Access

Optimal Meds

PARKINOSN EXERCISE REVOLUTION !!!