

Examining Exercise in Parkinson's Disease

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Overview

1. Brief introduction of Parkinson's disease
2. Recent research in exercise for Parkinson's disease
3. Exercise research at UBC
4. CSEP guidelines and benefits of exercise for adults over 65
5. Barriers to exercise in Parkinson's disease



Learning Objectives

1. Brief introduction of Parkinson's disease
 - **Basic understanding of PD symptoms and pathophysiology**
2. Exercise for Parkinson's disease
 - **Identifying some recent exercise research in Parkinson's Disease and implications for treatment**
3. Exercise research at UBC
 - **Understanding of how UBC is contributing to the body of knowledge of exercise research in PD**
4. CSEP guidelines and benefits of exercise for adults over 65
 - **Understanding current recommendations for exercise in adults over 65 in Canada**
5. Barriers to exercise in Parkinson's disease
 - **Discerning the most important barriers to exercise in PD and how to overcome exercise barriers**

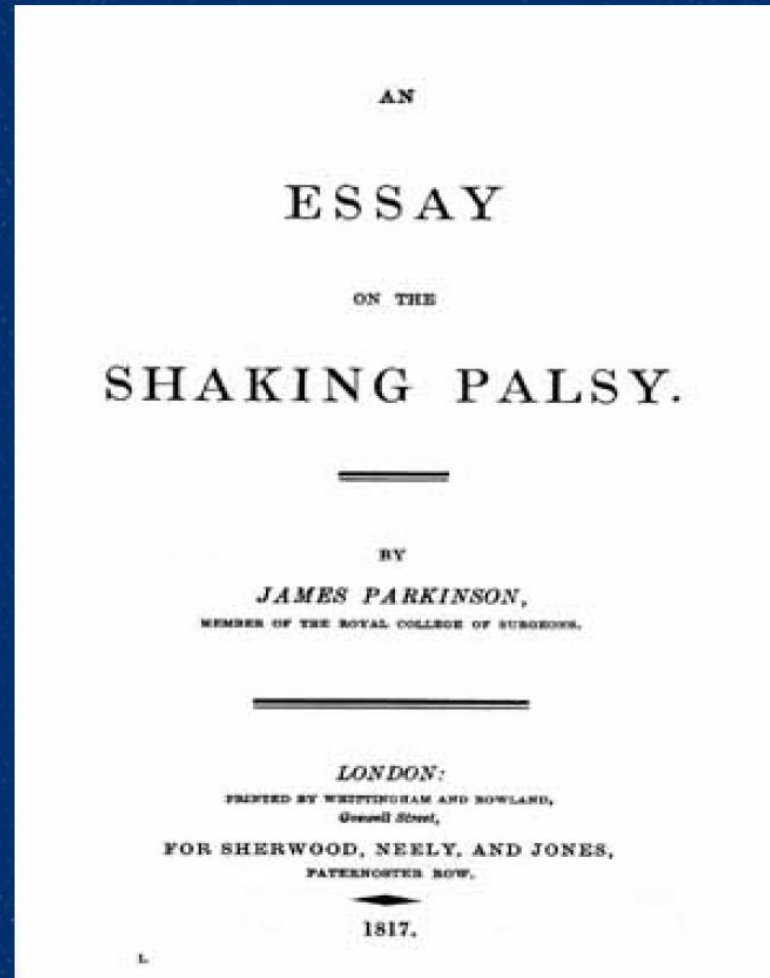


Parkinson's Disease

In 1817, James Parkinson's *Essay on the Shaking Palsy* outlined some of the cardinal symptoms of Parkinson's disease.

"Involuntary tremulous motion, with lessened muscular power, in parts not in action and even when supported; with a propensity to bend the trunk forwards, and to pass from a walking to a running pace: the senses and intellects being uninjured."

- James Parkinson, 1817

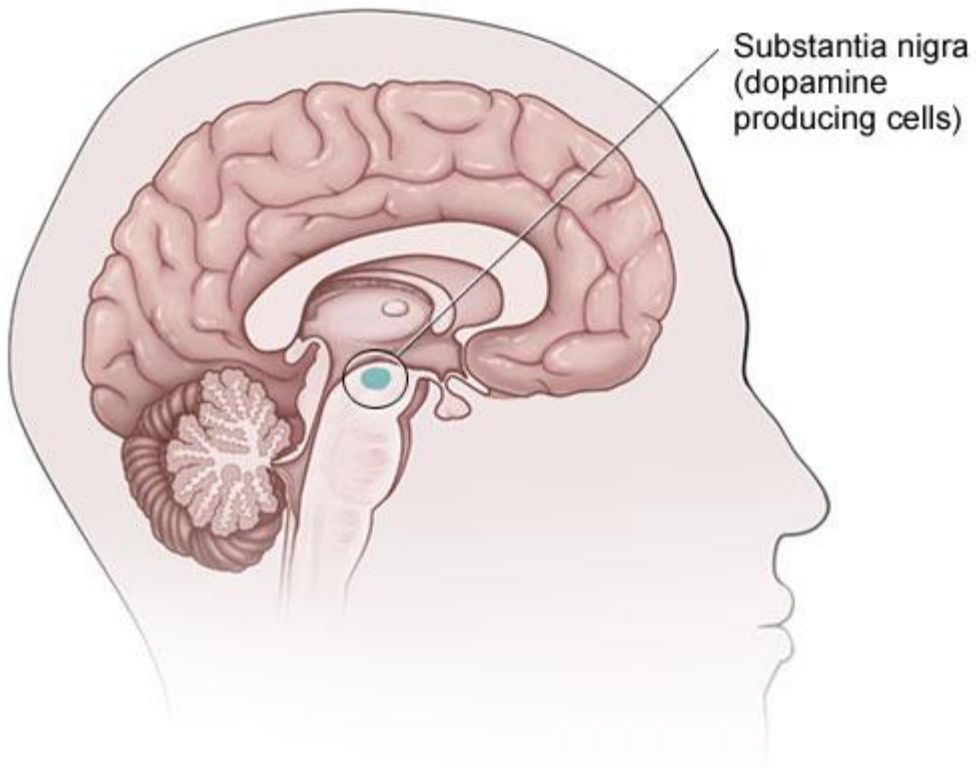


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Pathophysiology

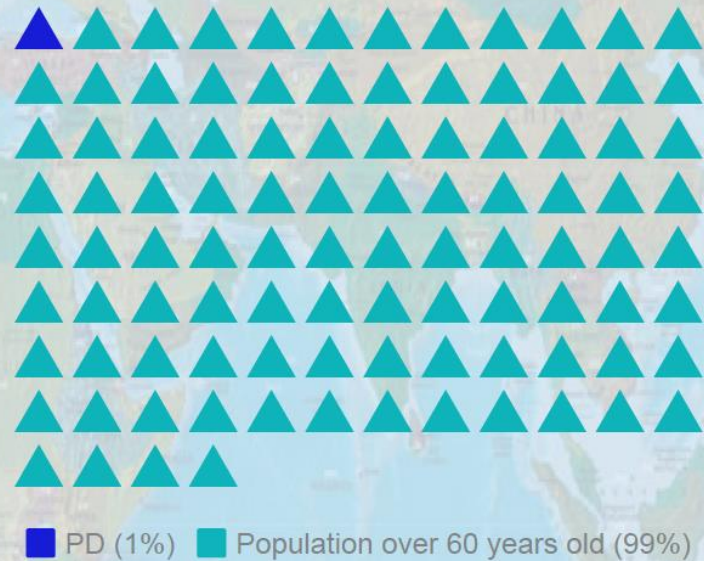
Parkinson's Disease



“PD is characterized neuropathologically by the presence of α -synuclein-containing Lewy bodies in the substantia nigra of the brain.” [1]



The prevalence of Parkinson's disease is 1 in 100 in populations over 60 years old.



- PD occurrence is increasing with the ageing population and the cause of PD remains unknown in most cases. [1]
- Known genetic foundations for PD are rare, making up approximately 5% -10% of the total PD population. [1]



Research and clinical care have also uncovered non-motor and prodromal **symptoms** of Parkinson's disease.

NON-MOTOR SYMPTOMS

- Mood disturbances
- Autonomic dysfunction
- Fatigue
- Pain
- Cognition changes
- GI dysfunction
- Perception distortion
- Sleep disturbances
- Attention deficits

MOTOR SYMPTOMS

- Bradykinesia
- Rigidity
- Tremor
- Gait disturbances
- Balance instability
- Dyskinesia
- Motor fluctuations
- Akinesia
- Speech difficulties

PRODROMAL SYMPTOMS

- Loss of sense of smell
- Depression
- Anxiety
- REM sleep behavior disorder
- Constipation

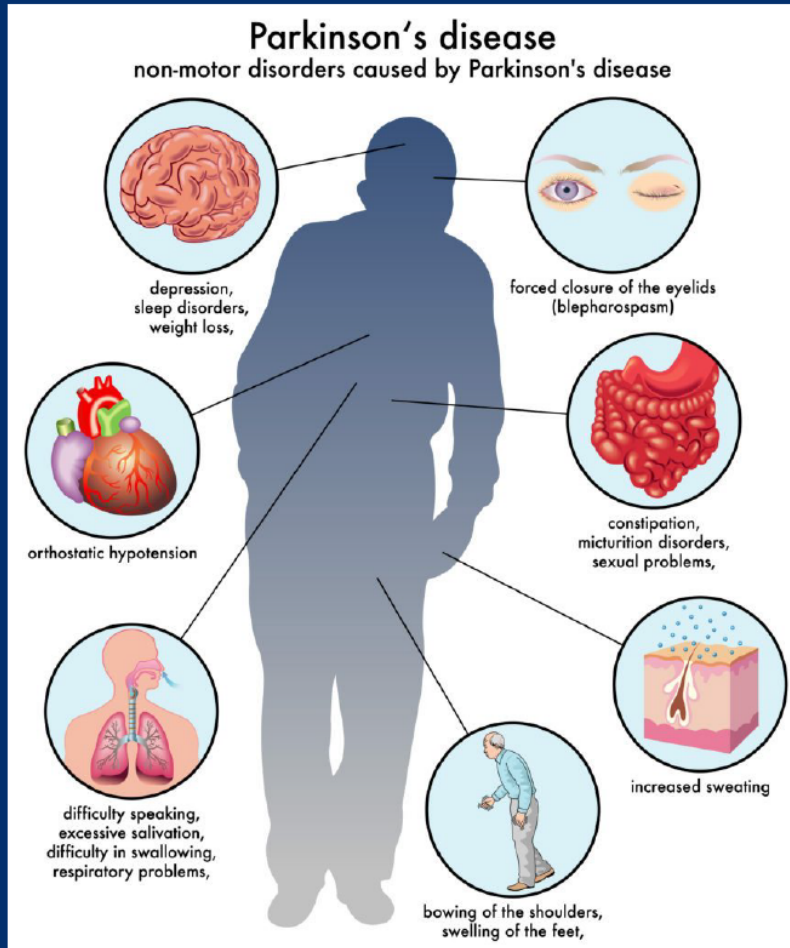
It should be noted that each person with Parkinson's disease is unique and may experience a different combination of symptoms. Many patients will experience some symptoms but not others, regardless of disease progression.



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Non-Motor Symptoms of Parkinson's Disease



Non-Motor symptoms in PD can often have a greater impact on health related quality of life than the motor symptoms of PD [3].

PD symptoms such as mood changes and apathy have the most negative impact on quality of life [3].



Non-Motor Symptoms

>50%

of Participants
EXPERIENCED THESE NON-MOTOR
SYMPTOMS

A multicenter, international, cross sectional study on 411 Parkinson's disease patients by Martinez-Martin et al. (2011) demonstrated the most common non-motor symptoms in PD to be nocturia, fatigue, and dribbling saliva. [3]

▲ 56.7%

Dribbling
Saliva

▲ 65.9%

Fatigue

▲ 68.4%

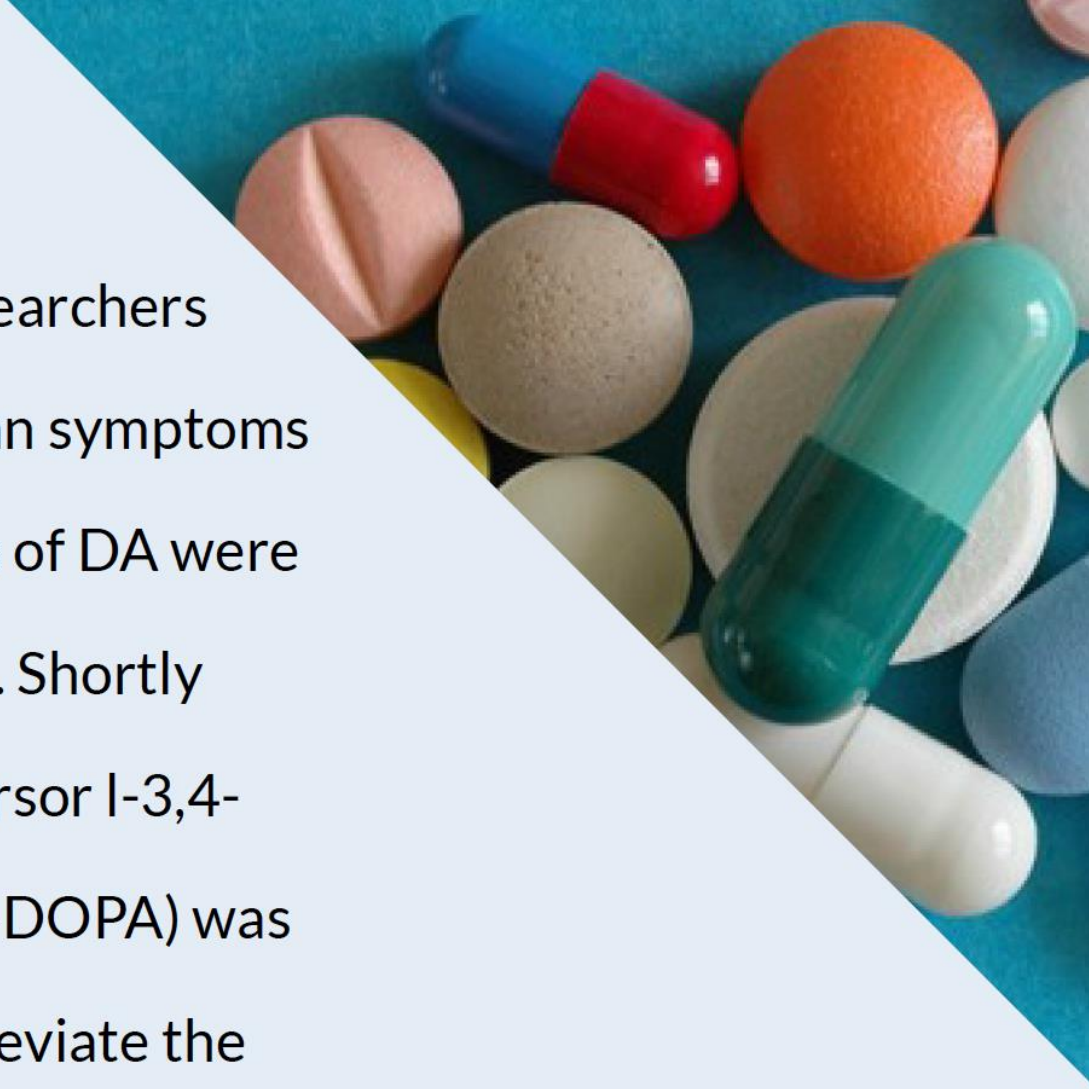
Nocturia

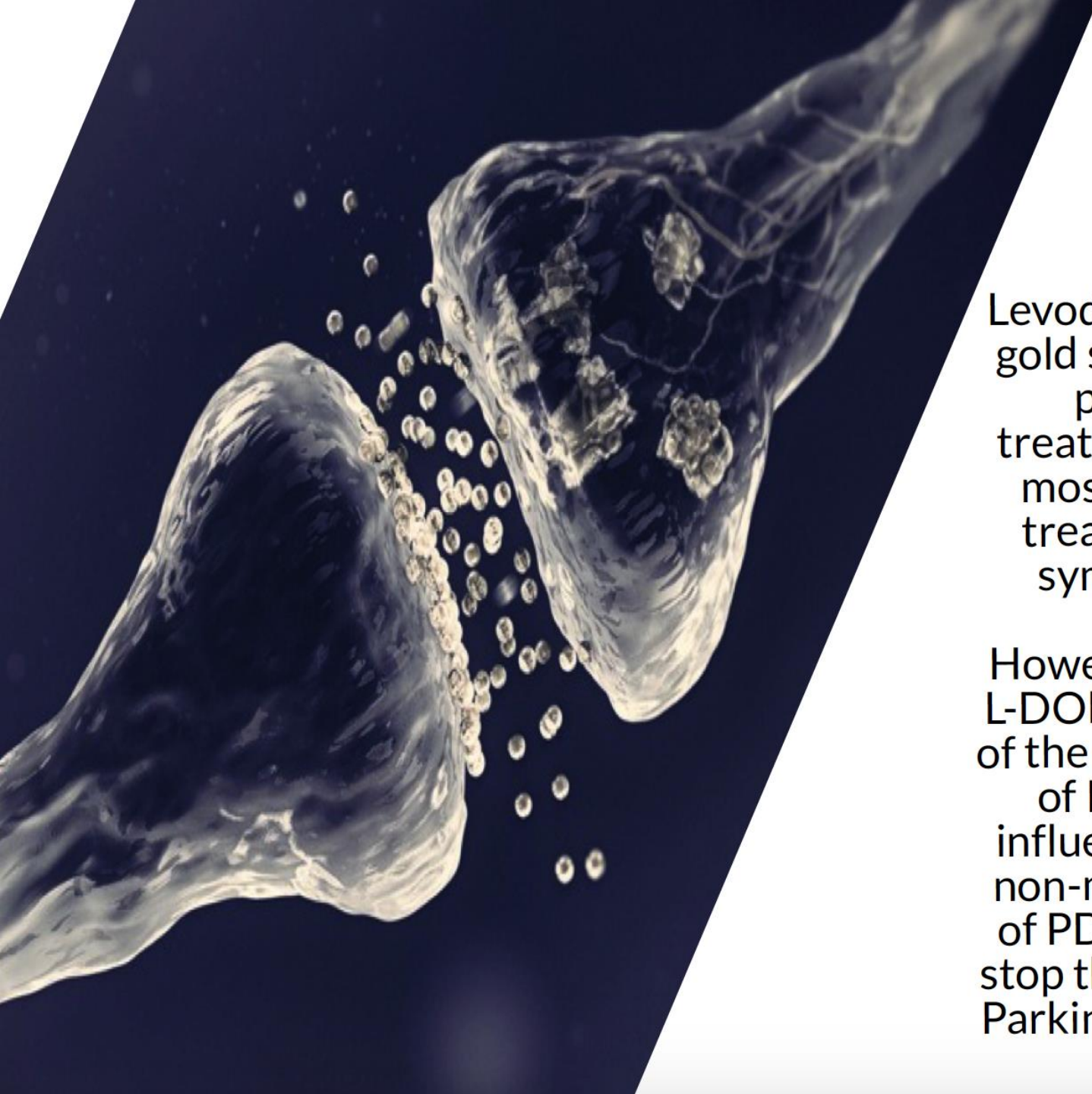


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"In the early 1960s, researchers discovered that parkinsonian symptoms appeared when brain levels of DA were reduced by 70% - 80% . Shortly thereafter, the DA precursor l-3,4-dihydroxyphenylalanine (L-DOPA) was shown to dramatically alleviate the slowness of movement, increased muscle tone and tremor that are typical of PD." [9]





Levodopa remains the gold standard in anti-parkinsonian treatment, as it is the most efficacious in treating the motor symptoms of PD.

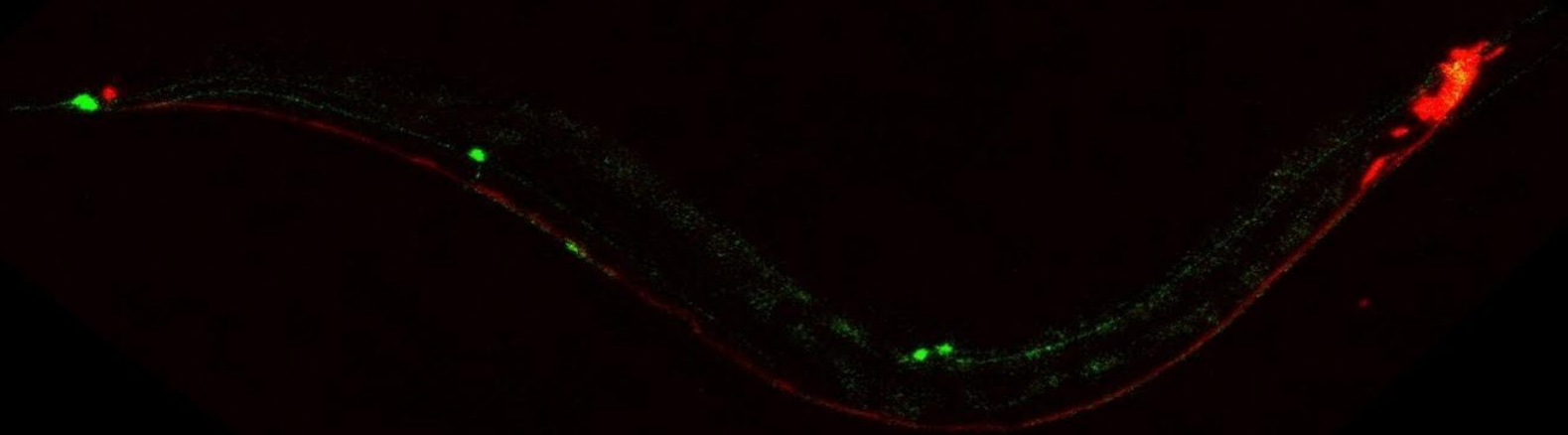
However, even though L-DOPA reduces many of the motor symptoms of PD, it does not influence some of the non-motor symptoms of PD, and it does not stop the progression of Parkinson's disease. [9]



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Recent Publications At a Glance



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Aquatic Therapy for PD

Aquatic therapy enables some people with PD to exercise while reducing the fear of falling.

A study by Carroll et al. (2017) had an intervention group of 11 participants attend two 45 minute sessions each week for 6 weeks.

Improvements were seen in UPDRS III score of the aquatic therapy group by 4.5 points. [10]

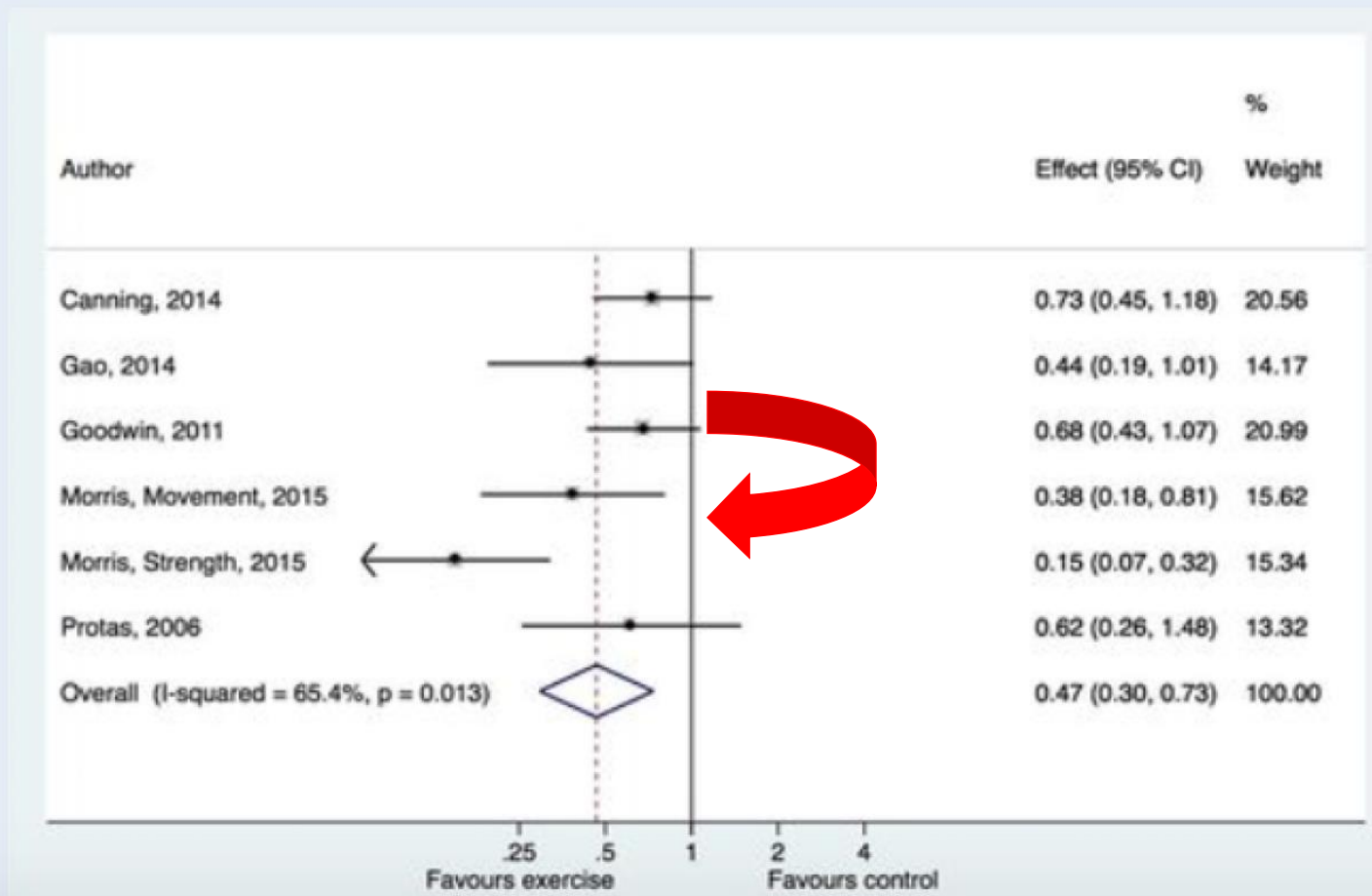
Variable	Aquatic Therapy Group (n=10)		Usual Care Group (n=8)		Intervention vs Usual Care Group
	T1	T2	T1	T2	Changes T1 to T2, <i>P</i>
Secondary outcomes					
UPDRS III	17.5 (8.75–21.25)	13 (5.25–16.25)	16.5 (10.25–21.25)	16.5 (11.25–21.75)	.01*
FOGQ	5.0 (3.75–8.25)	3.5 (1–9)	5.0 (2.25–13)	6.5 (3.5–12.75)	.17
PDQ-39	19.87 (7.69–31.48)	14.10 (7.21–24.15)	21.47 (17.54–28.21)	23.08 (13.48–28.85)	.20



Exercise to prevent falls in PD

A systematic review and meta-analysis by Sherrington et al. (2016) studied exercise to prevent falls in older adults, with a component focusing on PD.

There was evidence of a fall prevention effect in community-dwelling people with PD but this needs to be confirmed with further studies. [11]



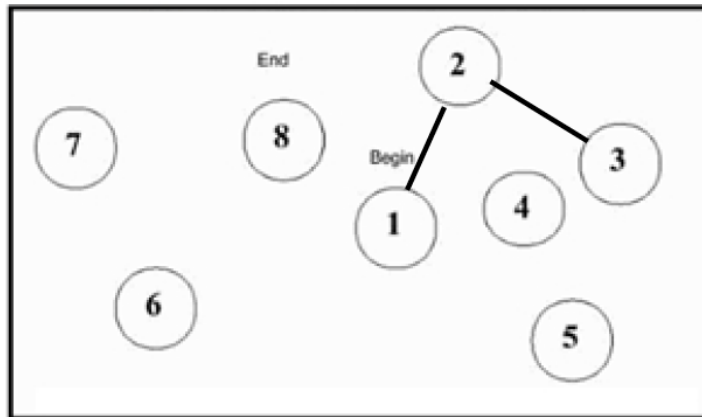
Treadmill Training Effects on Cognitive and Motor Symptoms of PD

A study by Picelli et al. (2016) investigated the effects of treadmill training on cognitive and motor features of patients with PD.

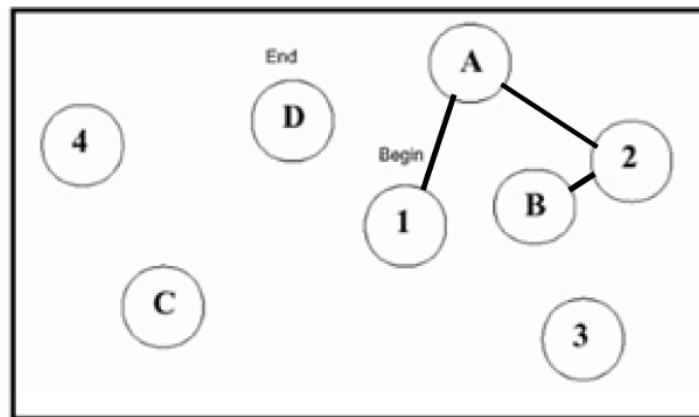
Seventeen participants were enrolled, with the treatment group having participated in twelve, 45 minute treadmill sessions.

Improvements were seen in MoCA, TMT (Part A and Part B), BDI, UPDRS, and 6MWT post-intervention. [12]

Test A



Test B



Exercise and Immunomodulation Research

Brain-derived neurotrophic factor (BDNF) is a molecule found in the brain that helps to prevent neuron death and helps to preserve neuron function.

Research demonstrates that routine exercise in people with PD has been shown to increase levels of BDNF. [13]

Zoladz et al. (2014) conducted a study to measure BDNF in PD patients before and after exercise training. [14]

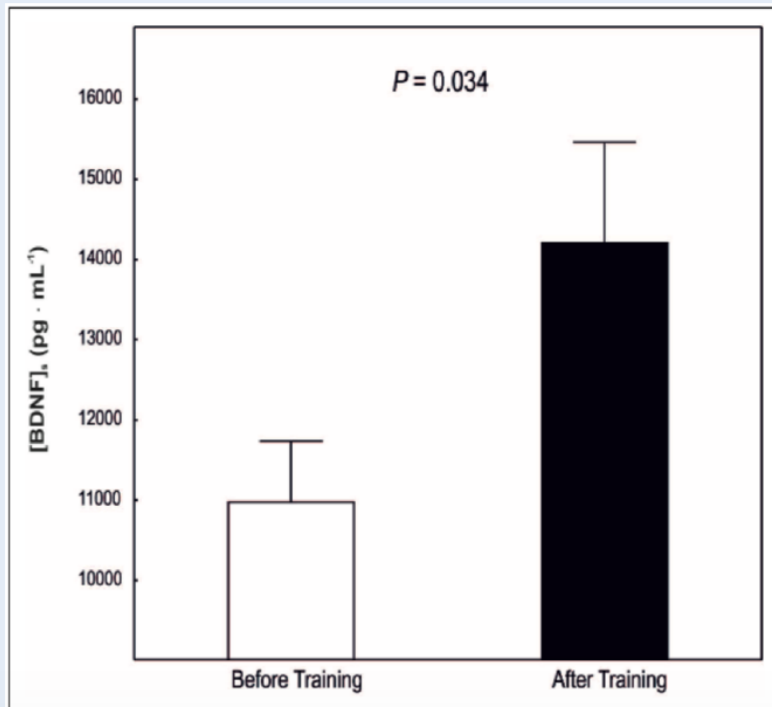


Fig. 2. Serum brain-derived neurotrophic factor level [BDNF]_s in the PD patients (n=12) before and after 8 weeks of training.



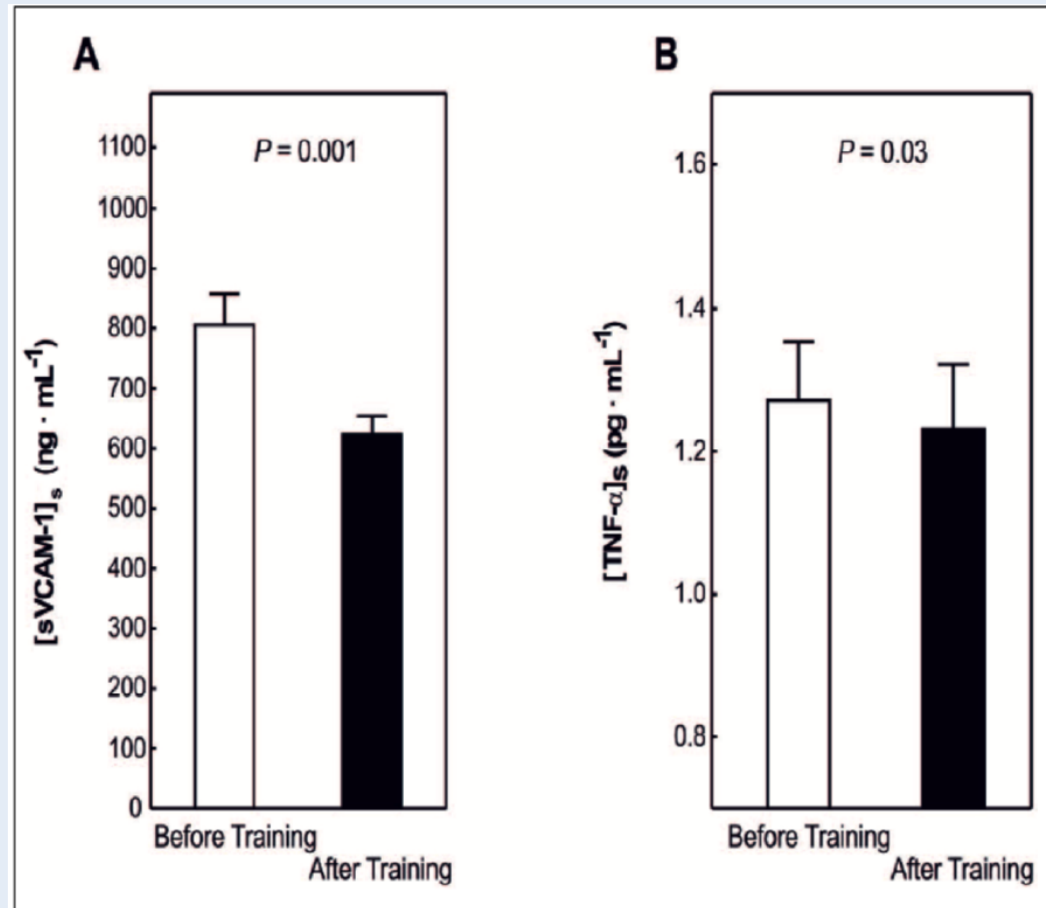


Fig. 3. Basal serum soluble vascular cell adhesion molecule-1 level $[sVCAM-1]_s$ in the PD patients before and after 8 weeks of training (panel A) and basal serum tumor necrosis factor level $[TNF-\alpha]_s$ in the PD patients before and after 8 weeks of training (panel B).

Zoladz et al. (2014) also measured pro-inflammatory markers in PD patients before and after exercise training. The results above show a reduction in pro-inflammatory markers after the exercise intervention. [14]



EXERCISE RESEARCH IN PARKINSON'S DISEASE AT UBC

Funded by:

Pacific Parkinson's
RESEARCH INSTITUTE

A. JON STOESSL, CM, MD, FRCPC, FCAHS
PROFESSOR & HEAD, NEUROLOGY;
CO-DIRECTOR, DJAVAD MOWAFAGHIAN CENTRE FOR BRAIN
HEALTH; CANADA RESEARCH CHAIR IN PARKINSON'S

MATT SACHELI CANDIDATE FOR DOCTOR OF PHILOSOPHY



Study Outline

THE THERAPEUTIC EFFECTS OF EXERCISE IN PARKINSON'S DISEASE (PD) ARE COMMONLY REPORTED, HOWEVER THE UNDERLYING MECHANISMS ARE UNKNOWN. DR. STOESSL AND MATT SACHELI DESIGNED A RESEARCH STUDY, FUNDED BY THE PACIFIC PARKINSON'S RESEARCH INSTITUTE, TO INVESTIGATE NEUROCHEMICAL CHANGES ELICITED BY EXERCISE IN A POPULATION OF SEDENTARY PEOPLE WITH A DIAGNOSIS OF PARKINSON'S DISEASE.



26 Sedentary Participants with Parkinson's Disease

BASELINE TESTING

Neurocognitive assessments
Motor assessments
Positron Emission
Tomography
VO2 Max Testing
fMRI

INTERVENTION

- 3 month intense aerobic exercise
- 3 month stretching/flexibility exercise
- Classes 3x per week
- 1 hr classes

REPEAT TESTING

- Neurocognitive assessments
- Motor assessments
- Positron Emission Tomography
- VO2 Max Testing
- fMRI

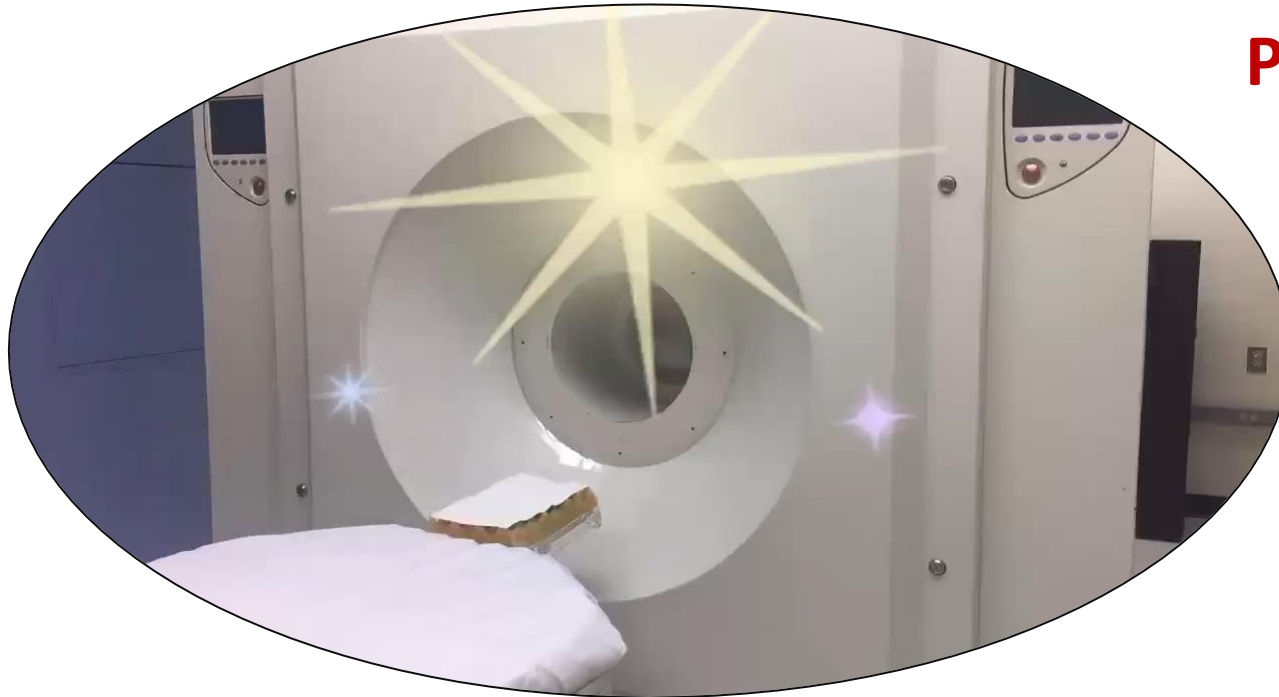
PET Scanning

- Positron Emission Tomography (PET) is an imaging procedure in which a radiotracer is injected through an intravenous (IV) line to investigate levels of neurochemicals and pathology.
- At UBC, radiotracers are created at TRIUMF using a cyclotron.
- Chemists at TRIUMF fuse together radioactive isotopes to small amounts of biomolecules, which act as a physiological labeler.
- Once the radiotracer enters the bloodstream of research participants through an IV, imaging begins using a PET scanning machine.
- Inside a PET scanning machine, there are thousands of crystals that capture radiation emissions from the body of the research participant.
- The crystals measure the amount of radiation emitted from different parts of the body creating an anatomical picture of radiotracer uptake.



Peripheral Benzodiazepine Receptor (PBR) PET scanning:

- Allows researchers to investigate neuroinflammation.
- **STUDY AIM:** To establish if aerobic exercise contributes to changes in neuroinflammation levels.

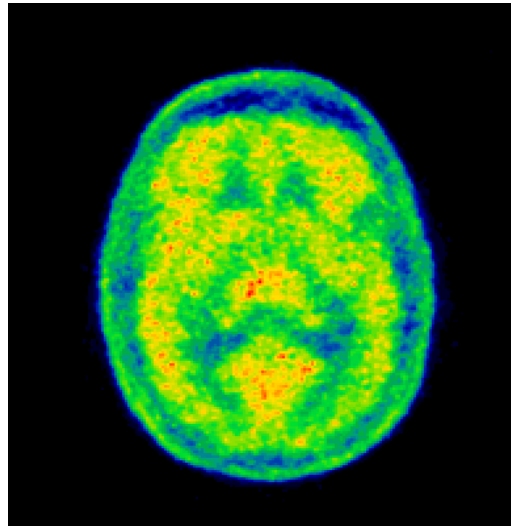


PBR PET



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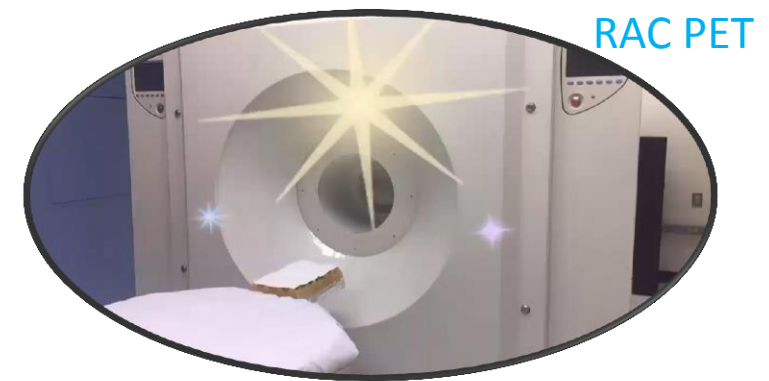
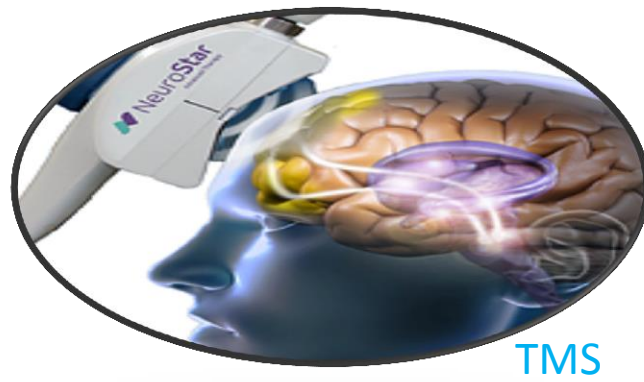
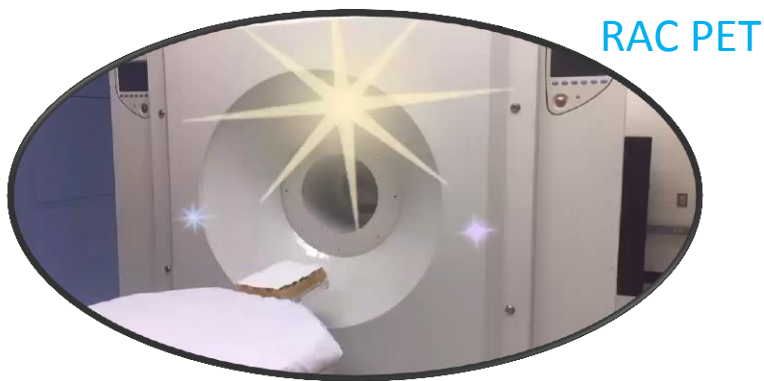


PBR PET



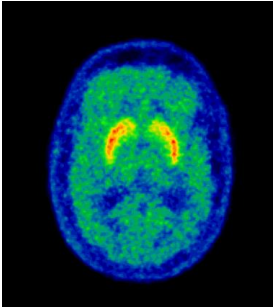
Raclopride PET Scanning:

- Allows researchers to measure DOPAMINE release in the brain.
- Higher amounts of DOPAMINE release stimulated by TMS = Enhanced ability of the brain to release DOPAMINE
- STUDY AIM: Does aerobic exercise increase the ability of neurons to release DOPAMINE?

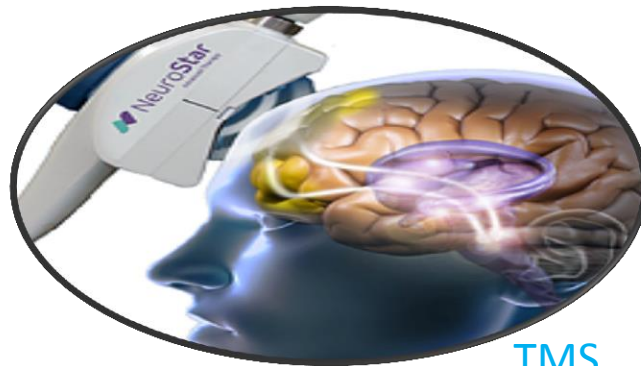


Raclopride PET Scanning:

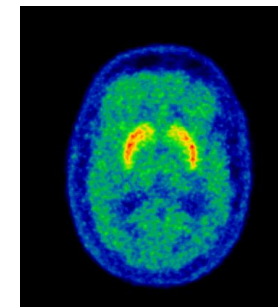
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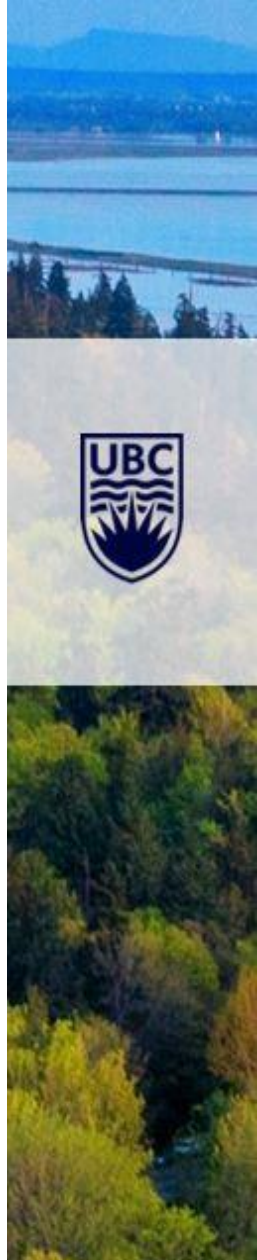
RAC PET



TMS

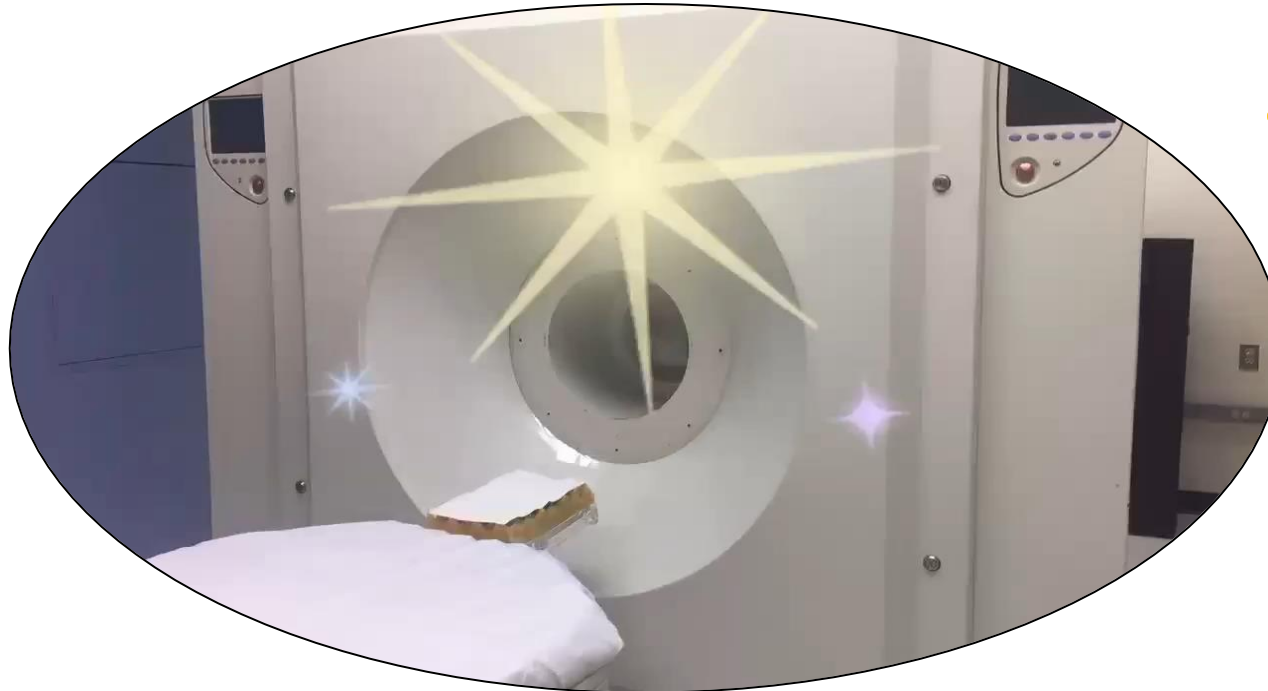


RAC PET



Tetrabenazine (TBZ) PET SCANNING:

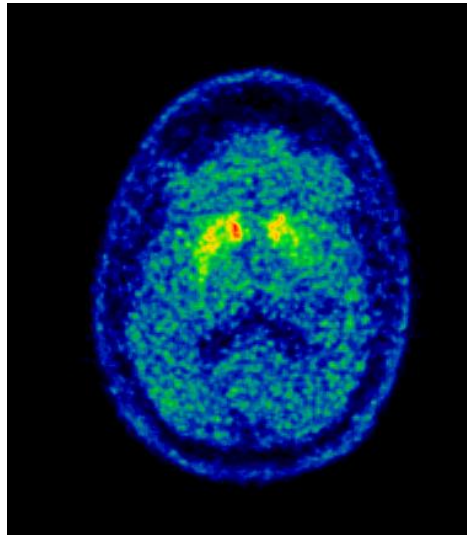
- Allows researchers to investigate the amount of dopamine producing cells in the brain.
- **STUDY AIM:** Does aerobic exercise slow the progression of Parkinson's disease? (Are DOPAMINE producing cells preserved?)



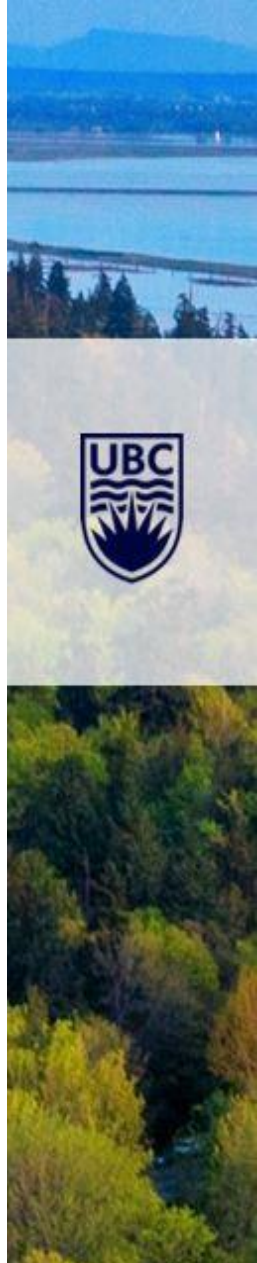
TBZ PET

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TBZ PET



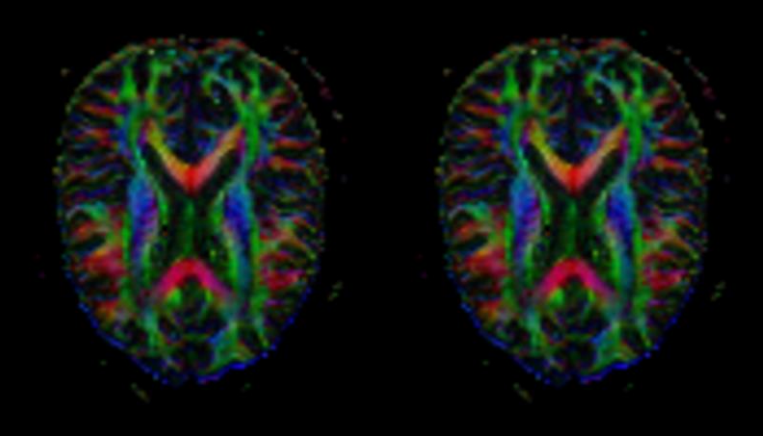
VO2 MAX TESTING

Measures exercise endurance capacity and cardio fitness

➤ STUDY AIM:

Did the routine aerobic exercise study group improve their fitness level?

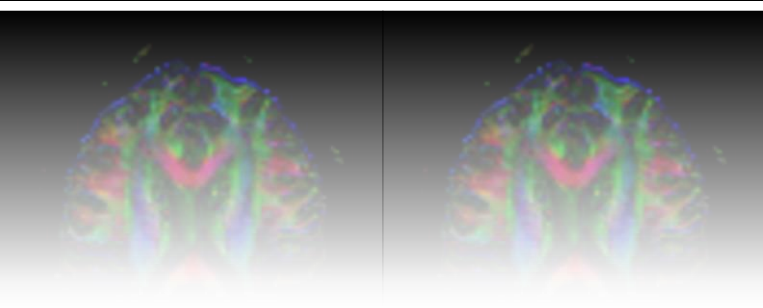
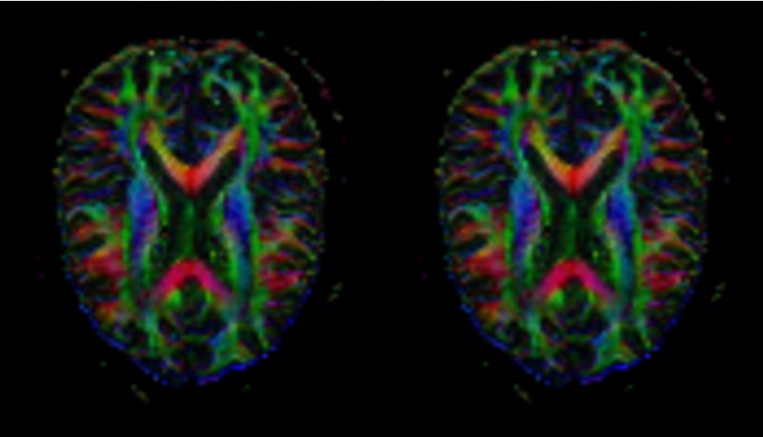
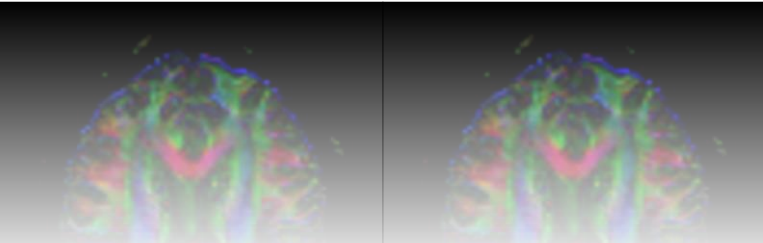




Functional Magnetic Resonance Imaging (fMRI)

An imaging technique that uses a magnetic field to detect changes in blood flow and brain activity.

- **STUDY AIM:** How does exercise alter motivation and response to reward in the brain?



A Prescription for Exercise?





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Readiness to Exercise

➤ Is it safe? Get Active Questionnaire

 YES ⋮ ▼	 NO ⋮ ▼	PREPARE TO BECOME MORE ACTIVE
<input type="radio"/>	<input type="radio"/>	1 Have you experienced <u>ANY</u> of the following (A to F) within the past six months?
<input type="radio"/>	<input type="radio"/>	A A diagnosis of/treatment for heart disease or stroke, or pain/discomfort/pressure in your chest during activities of daily living or during physical activity?
<input type="radio"/>	<input type="radio"/>	B A diagnosis of/treatment for high blood pressure (BP), or a resting BP of 160/90 mmHg or higher?
<input type="radio"/>	<input type="radio"/>	C Dizziness or lightheadedness during physical activity?
<input type="radio"/>	<input type="radio"/>	D Shortness of breath at rest?
<input type="radio"/>	<input type="radio"/>	E Loss of consciousness/fainting for any reason?
<input type="radio"/>	<input type="radio"/>	F Concussion?



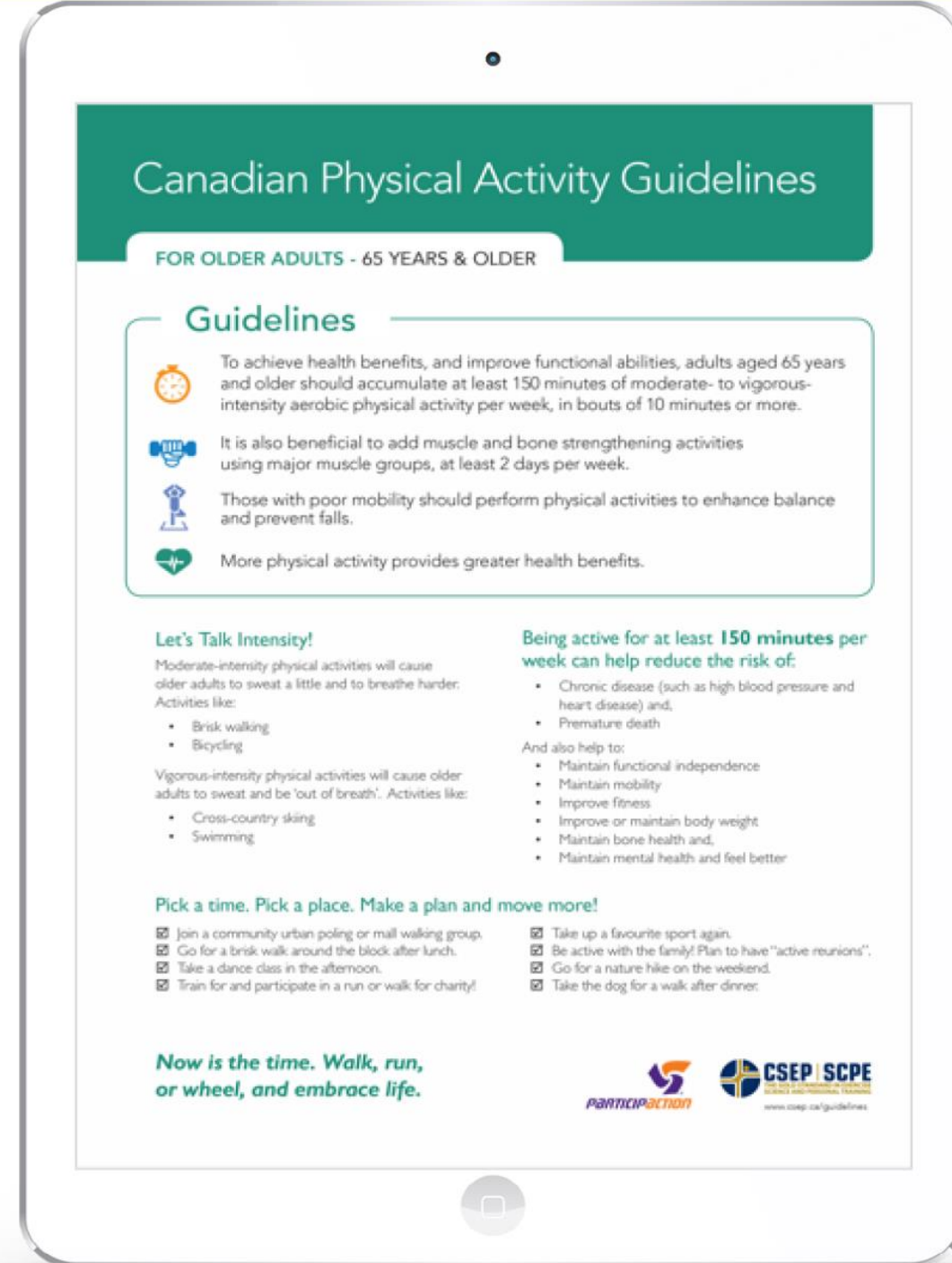
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CSEP Guidelines

The Canadian Society for Exercise Physiology (CSEP) is a voluntary organization composed of professionals interested and involved in the scientific study of exercise physiology, exercise biochemistry, fitness and health. [15]

Parkinson's disease is most commonly diagnosed in people over the age of 60. The CSEP guidelines reviewed for this webinar will be directed at adults over the age of 65.



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To achieve health benefits and improve functional abilities, adults aged 65 years and older should accumulate at least 150 minutes of moderate-to vigorous- intensity aerobic physical activity per week, in bouts of 10 minutes or more.



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It is also beneficial to add muscle and bone strengthening activities using major muscle groups, at least 2 days per week.



CSEP | SCPE



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Those with poor mobility should perform physical activities to enhance balance and prevent falls.



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More physical activity provides greater health benefits.



CSEP | SCPE



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+ **01**

Vigorous Exercise

Intense activities that cause heavy sweating and a sensation of feeling "out of breath".

+ **02**

Moderate Exercise

Activities that will cause light sweating and faster, deeper breathing.

+ **03**

Light Exercise

Activities that do not cause sweating and allow conversation with no shortness of breath.

Advising Intensity



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A group of five people (three women and two men) are in a gym, performing a high-kick exercise. They are all smiling and looking towards the camera. The gym has a light-colored wooden floor and white walls. A dark blue banner with the text 'Aerobic Exercise' is overlaid on the image.

Aerobic Exercise

So, what is aerobic exercise?

Aerobic exercise stimulates and strengthens the heart and lungs, thereby improving the body's utilization of oxygen.

Examples include jogging, rowing, swimming, or cycling.
[16]



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Exercise TIPS FROM



MICHELLE

PHYSIO
THERAPY

Michelle McCarthy is an experienced
PHYSIOTHERAPIST specializing in MOVEMENT
DISORDERS at the Djavad Mowafaghian Centre for
Brain Health at UBC

- Choose an activity that you **ENJOY** - this way you will be more likely to stick to it
- Consider doing exercise with a **FRIEND or PARTNER** - It is helpful to have someone to motivate you, keep you on track and increase your feelings of safety while exercising
- Exercise at the **BEST TIME OF DAY** for you - It may be best to exercise while you are "ON" your medications



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Exercise TIPS FROM



MICHELLE

- Set realistic **GOALS**
- Incorporate exercises into your **DAILY ACTIVITIES**
- Try to get a **BALANCE** of exercise throughout the week - consider cardio, balance, posture, stretching and strengthening exercises
- Consider what type of exercise you prefer - **INDIVIDUAL** exercises vs **GROUP** or class exercises



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SMART Goal Setting

Specific	Measurable	Achievable	Realistic	Timely
S G	M O	A A	R L	T S
What do you want to do?	How will you know when you've reached it?	Is it in your power to accomplish it?	Can you realistically achieve it?	When exactly do you want to accomplish it?



Ideas for becoming more active throughout the day

- Do errands on foot
- Take the dog for a walk
- Sweep the walkway
- Do calisthenics in the morning
- Combine exercise and housework



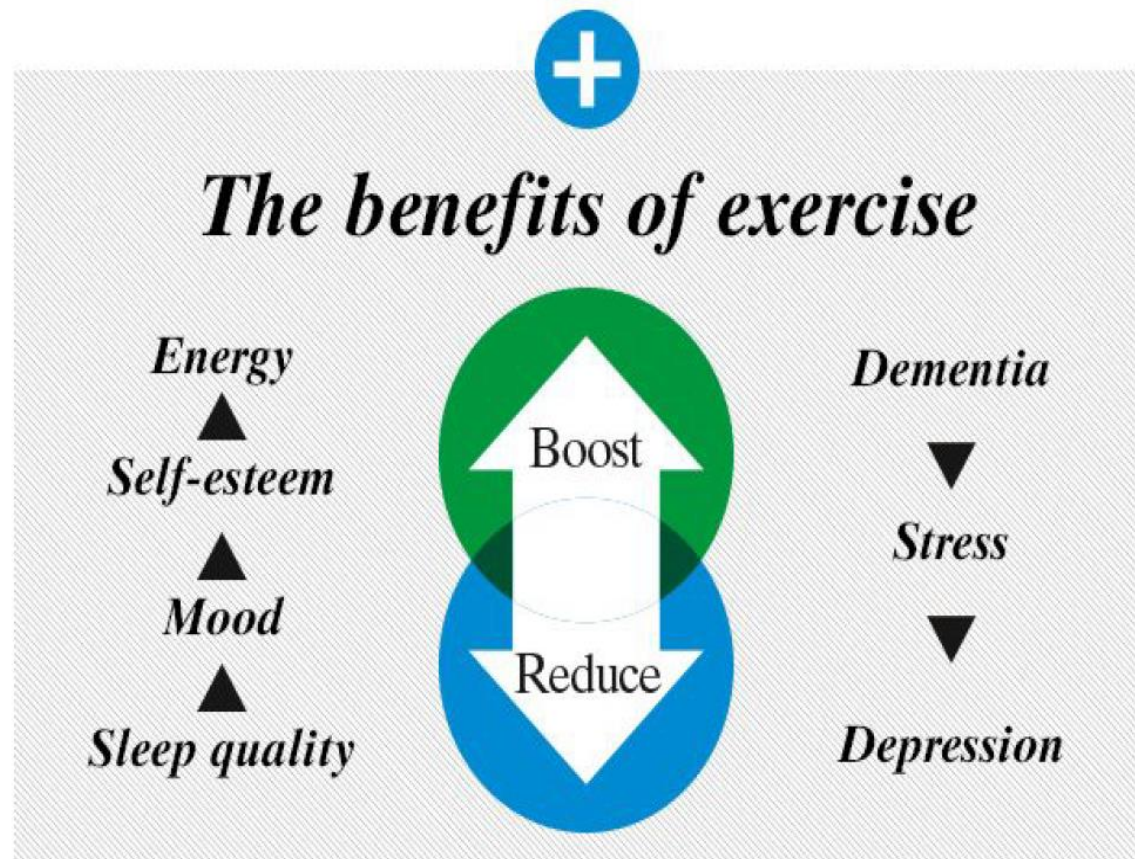
Warm-Up and Cool-Down

Warm-up sessions should include low-intensity, whole-body movements similar to those in the activity that will follow.

Cool-down sessions should consist of 5-10 minutes of reduced activity, and should follow every workout to allow heart rate, breathing, and circulation to return to normal.



General Health Benefits of Exercise



- Maintain functional independence
- Maintain mobility
- Improve fitness
- Improve or maintain body weight
- Maintain bone health
- Maintain mental health and feel better [15]



**A 20-minute workout
can elevate your
mood for up to 12
hours.**



**Physical activity
boosts self esteem.**



**Physical activity can
reduce pain, morning
stiffness, inflammation
and even fatigue.**



**Participating in a
variety of exercises
can add years
to your life.**



**82% of Canadians
think that the only way
to be physically active
is for it become a
habit.**



**Physical inactivity
costs the Canadian
economy \$6.8 billion
dollars each year.**



Inspirational Quotes from PARTICIPACTION

<https://www.participaction.com/en-ca>



**Djavad Mowafaghian
CENTRE FOR BRAIN HEALTH**



**People who exercise
fall asleep faster.**



**People with an
accountability partner
are more likely to
reach their goals.**



**Time outdoors
increases
energy levels.**



**Scientific fact:
the only way to reach
your goals is to keep
going.**



**8 in 10 Canadians think
physical inactivity is a
serious health issue.**



**Physical activity can
help with stress,
anxiety, depression
and negative thoughts.**



Inspirational Quotes from PARTICIPATION

<https://www.participation.com/en-ca>



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Tai Chi

Integrates balance, flexibility, and coordination training.

Li et al. (2012) found that 24 weeks of Tai Chi training resulted in a decrease of 12% monthly fall rates compared to resistance training and seated stretching controls.

Tai Chi is an effective approach for fall prevention in Parkinson's disease. [18]



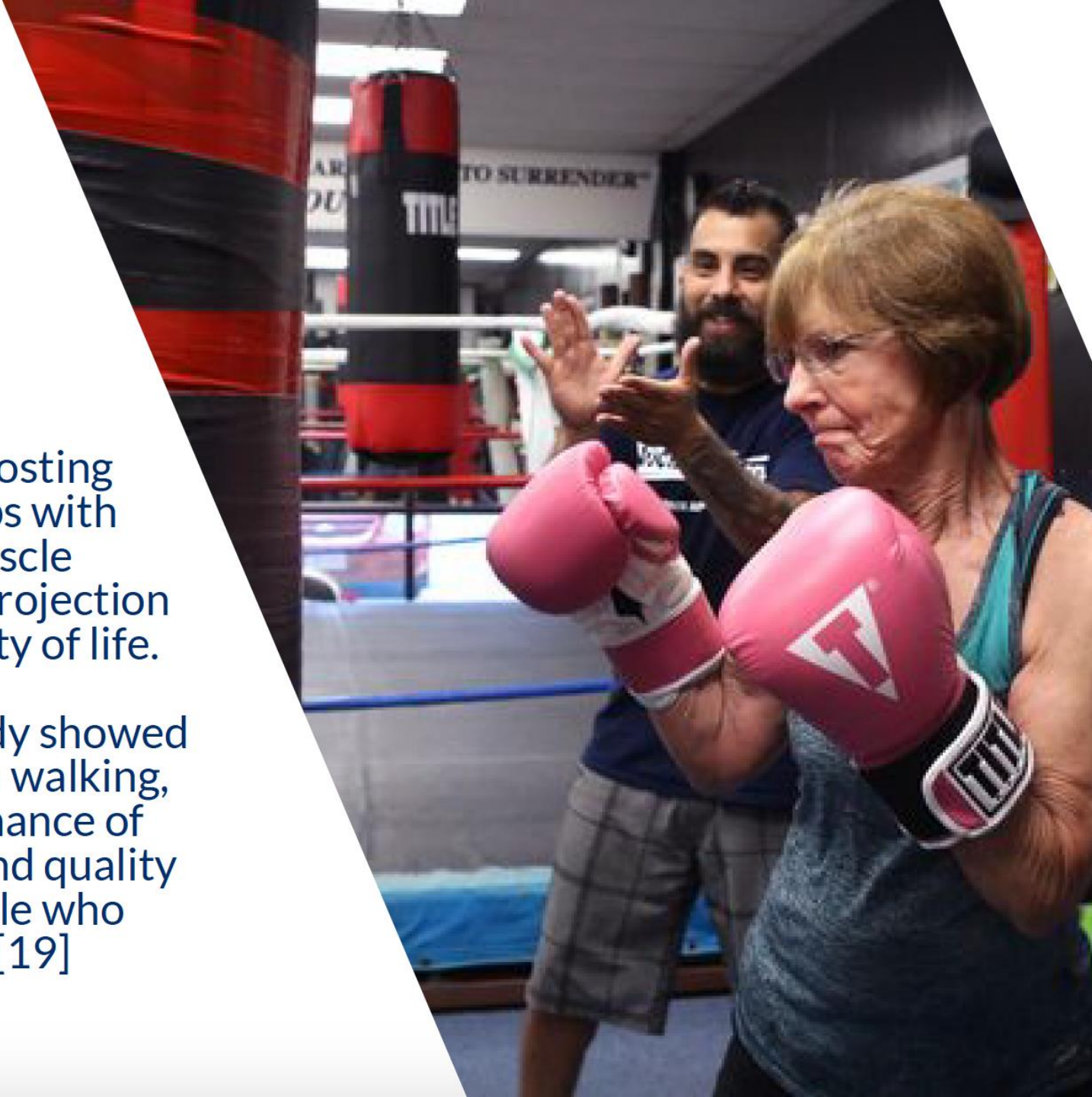
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Boxing

A confidence-boosting activity that helps with gait, posture, muscle strength, vocal projection and overall quality of life.

A 2011 case study showed improvements in walking, balance, performance of daily activities and quality of life in six people who boxed regularly. [19]



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Barriers to Exercise in Parkinson's Disease

Low Outcome Expectation from Exercise

“Older adults who believed that physical activity promoted better health were more than twice as likely to initiate physical activity”. [20]



Lack of Time to Exercise

"The lack of time to exercise, identified in the present study, may reflect difficulty prioritizing and planning daily activities". [20]



Fear of Falling

Research shows that people with PD have more fear of falling than older adults who are healthy. [20]



A study conducted by Ellis et al. (2013) established the above perceived exercise barriers to be the most important factors to limit adherence to exercise in people with Parkinson's Disease who are ambulatory and live in the community. [20]





Overcoming Hurdles

Exercising and Parkinson's Disease



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Low Outcome Expectation from Exercise

- Educating people about the health-related benefits of exercise is important and may alter exercise outcome expectations
- Goal setting
- Feedback (Peer, personal trainer, caregiver, self, physiotherapy)
- Relapse prevention training
- Journaling/Reflection



Lack of Time to Exercise



- Prioritizing
- Scheduling exercise as part of a daily routine
- Incorporating exercise into social or work activities
- Asking for assistance from family or friends with scheduling and planning times to exercise
- Asking family and friends to reinforce scheduled exercise activities



Fear of Falling

- Education about a realistic self-assessment of the risk of falling
- Environmental safety factors – avoid unlevelled, slippery walking surfaces, wear proper walking/exercising equipment – running shoes, clothing that does not interfere with movement.
- Seek assistance in situations when experiencing fear of falling
- Promotion of physical activity and physical fitness



Fear of Falling

- Ask your family doctor for a bone density check and ask if they recommend calcium and vitamin D supplementation to assist in maintaining healthy bones
- Walking aids – cane, hiking poles, walker to assist with ambulatory movement
- Completing supine or seated exercises
- Supervised water fitness classes – walking/ambulatory movements in waist depth water



Learning Outcomes

1. Basic understanding of PD symptoms (motor, non-motor, and prodromal)

PD Pathophysiology – Dopamine Deficiency in PD causes motor dysfunction (PD symptoms of tremor and stiffness occur when the nerve cells fire and there isn't enough dopamine to transmit the neuronal messages)

Sinemet or Levodopa is the “gold standard” medication for the treatment of PD but it has limitations as it can cause motor fluctuations and motor complications

PD occurrence is 1 in 100 in populations over 60 years old



Learning Outcomes

2. Interpretation of some recent exercise literature in Parkinson's disease and implications for treatment

Therapeutic effects in PD after aquatic therapy and treadmill exercise

Reported benefits of tai chi and boxing in PD

Exercise-induced changes in neuroinflammation in people with a diagnosis of PD

An understanding that more high quality research studies investigating the benefits of exercise in PD are necessary to substantiate or further validate the current research



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Learning Outcomes

3. Insight of a study at UBC that will contribute to the body of knowledge of exercise research in PD

A basic understanding of the study protocol and procedures for Dr. Stoessl and Matt Sacheli's exercise in PD study (cognitive and motor assessments, VO2 max testing, PET scanning, fMRI scanning, exercise interventions)

Main study goal: To identify exercise-induced neurochemical changes that contribute to the motor and non-motor benefits seen in people with PD who exercise

Does exercise preserve dopamine producing neurons?

Does exercise increase the ability of neurons to release dopamine?

Does exercise cause changes in neuroinflammation?

Does exercise cause changes in the reward/motivation response in the brain?

Did the routine aerobic exercise study group improve their fitness levels?

Does exercise improve motor function and cognition in people with PD?



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Learning Outcomes

4. Understanding CSEP's recommendations for exercise in adults over 65
 - 150 minutes of moderate to vigorous exercise per week
 - Incorporate muscle and bone strengthening exercises 2 days per week
 - Perform activities to enhance balance and prevent falls
 - More physical activity = Greater health benefits



Learning Outcomes

5. Ability to recognize the most important barriers to exercise for people with Parkinson's disease:

- Low outcome expectation
- Lack of time
- Fear of falling

Knowledge of resources to overcome these barriers to exercise



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Thank you!

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Slide 5: Unknown. An illustration showing the location of the substantia nigra. Retrieved from <http://healthfore.com/blog/2014/03/13/7-tesla-mri-solving-the-mystery-behind-parkinsons/>

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Resources

**Is it Safe to Exercise? Physical Fitness Assessment Questionnaire -
Complete with family physician before engaging in exercise**

http://www.csep.ca/CMFiles/GAQ_CSEPPATHReadinessForm_2pages.pdf

Exercise Guidelines For Canadians

<http://csepguidelines.ca/>

Exercise classes for people living with PD in BC

<https://www.parkinson.bc.ca/resources-services/exercise-active-living>

Pacific Parkinson's Research Centre

<https://parkinsons.ubc.ca/wp/>

ParticipACTION

<https://www.participation.com/en-ca>



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