

Oxygen Cost of Walking in Individuals with Mild-to-Moderate Parkinson Disease ON vs. OFF Medication

Brynne Gould, SPT
Kyrsten Le, SPT



Background

Parkinson disease (PD)

- PD is the second most common diagnosed neurodegenerative disease in North America (Willis 2022)
- Motor symptoms of PD result in gait disturbances that impact functional mobility and independence. (Kim 2018, Hausdorff 2009, Zanardi 2021)

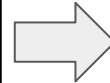
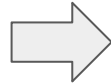
Symptoms

- Bradykinesia
- Hypokinesia
- Rigidity
- Tremor
- Postural Instability

Gait Impairments (Hausdorff 2009)

- Decreased gait speed
- Shorter stride length
- Reduced trunk and limb movement

Increased falls risk and decreased participation



Oxygen Cost of Walking

- Gait impairments → increased oxygen cost of walking or worse walking economy (Jeng 2020; Buoite 2020; Serra 2016)
- People with mild-to-moderate PD demonstrate a higher metabolic cost of walking during overground walking compared to healthy controls (Jeng 2020)



PD Treatment - Dopaminergic Medication

- Dopaminergic medications aim to increase dopamine levels in the brain to address motor symptoms of PD
- Medication has a mixed effect regarding the alleviation of gait disturbances in people with PD (Smulders 2016; Avila de Oliveira 2021)



Previous Literature

- Limited understanding regarding the potential effect of dopaminergic medication on walking economy in people with PD
- More recent evidence suggests that dopaminergic medication may not influence metabolic cost of walking when walking at a constant speed on a treadmill (Padmanabhan 2021)



Purpose:

To determine the effect of dopaminergic medications on metabolic cost and gait in people with PD when walking overground

Hypothesis:

We hypothesized that dopaminergic medication will have a beneficial impact on spatiotemporal parameters of gait; therefore, people with PD will exhibit more efficient gait that decreases oxygen consumption

Research Questions

1

What is the effect of dopaminergic medication on oxygen cost of walking?

2

What is the effect of dopaminergic medication on spatiotemporal parameters of gait?

3

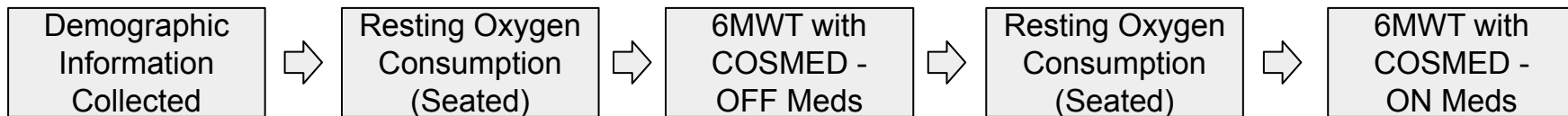
What is the effect of dopaminergic medication on endurance?

4

What is the relationship between changes in spatiotemporal parameters of gait and changes in oxygen cost of walking?

Methods

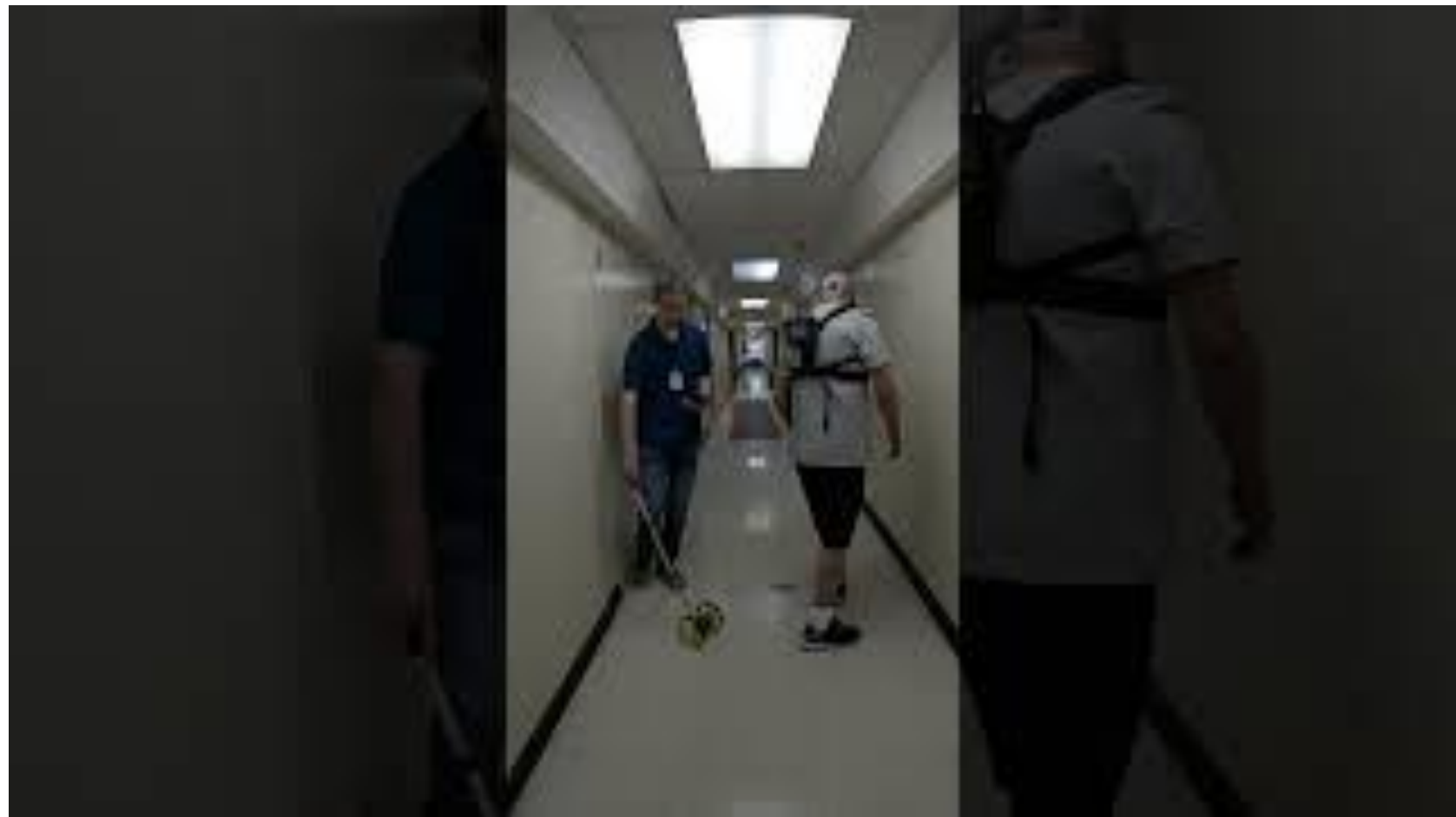
Design



Participants come to lab
OFF medication for at
least **12 hours**

Participants take
dopaminergic medication





Participants

Subject	Height	Weight	Chronicity	HY	MDS UPDRS
1	5'9	145	9 years	2	21
2	5'3	100	4 years	2	36
3	5'8	180	Not Reported	2	26
4	6'1	230	5 years	2	21
5	5'7	203	2 years	2	28
6	5'6	130	3 years	2	22
7	5'7	113	2 years	2	20
8	5'8	212	7 years	1	Not Reported

Exclusion Criteria

- Receiving physical therapy
- DBS surgery
- Uncontrolled cardiorespiratory or metabolic disease
- Presence of other neurological conditions
- Orthopedic injury that impacts gait

Data Analysis

- Mann-Whitney U test
- Spearman correlation analysis

Measures



Distance per minute on 6MWT
Total distance on 6MWT
“Endurance Index”



Spatiotemporal parameters of gait including:

- Stride length
- Step width
- Cadence
- Gait speed



- Resting oxygen consumption
- Oxygen Cost of Walking (mL/kg/m)
- Metabolic power

Results

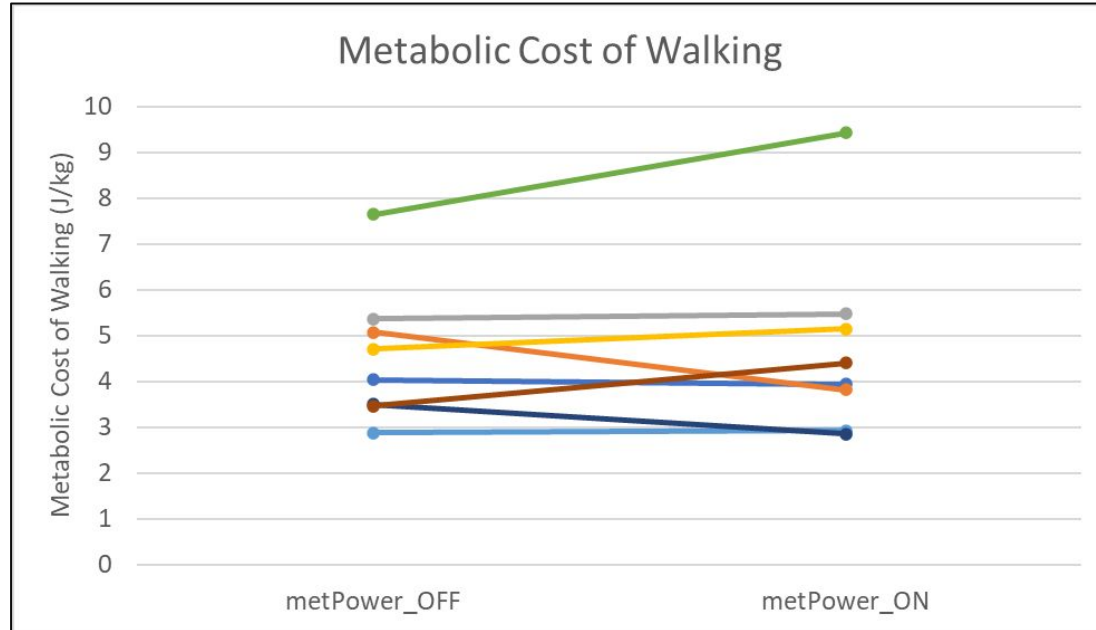
1**Effect of Dopaminergic Medication on Metabolic Cost of Walking**

No significant difference between oxygen cost of walking ON versus OFF medication walking overground at a self-selected speed

	OFF Medication	ON Medication	P-Value
Metabolic Cost of Walking	Median = 4.37 IQR = 1.82	Median = 4.17 IQR = 2.24	P = 0.575

1

Effect of Dopaminergic Medication on Metabolic Cost of Walking



2

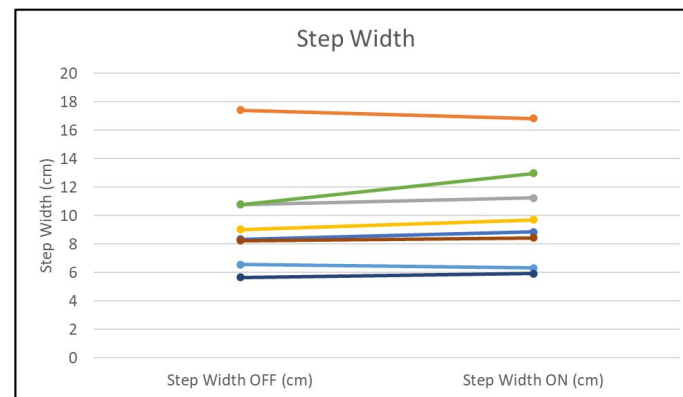
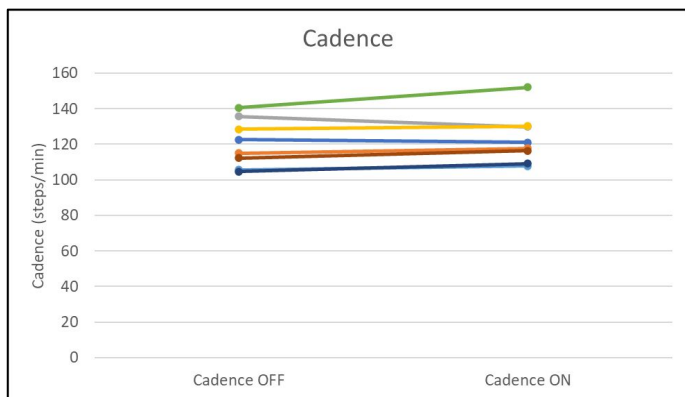
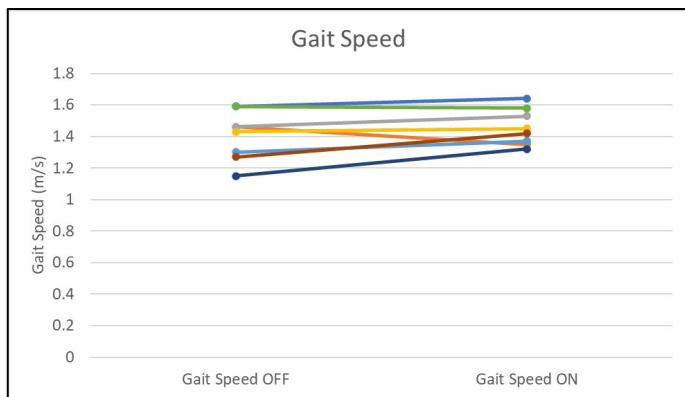
Effect of Dopaminergic Medication on Spatiotemporal Parameters of Gait

No significant difference between spatiotemporal parameters of gait ON versus OFF medication

	OFF Medication	ON Medication	P-Value
Gait Speed	Median = 1.45 IQR = 0.28	Median = 1.44 IQR = 0.21	P = 0.123
Stride Length	Median = 135.66 IQR = 18.57	Median = 141.40 IQR = 17.40	P = 0.674
Cadence	Median = 118.76 IQR = 26.49	Median = 119.36 IQR = 19.28	P = 0.161
Step Width	Median = 8.68 IQR = 3.79	Median = 9.28 IQR = 5.69	P = 0.161

2

Effect of Dopaminergic Medication on Spatiotemporal Parameters of Gait



3

Effect of Dopaminergic Medication on Endurance

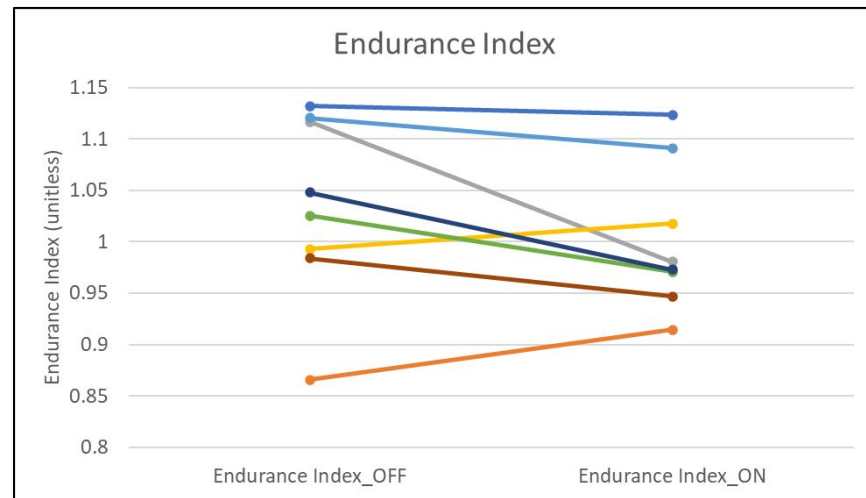
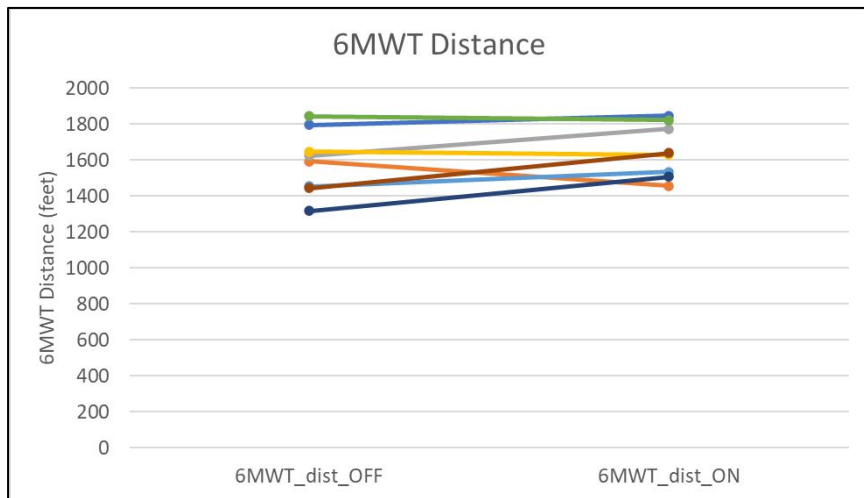
There was no significant difference between total distance traveled during the 6MWT ON versus OFF medication.

There was no significant difference between endurance index ON versus OFF medication.

	OFF Medication	ON Medication	P-Value
Total Distance During 6MWT	Median = 1,609.5 IQR = 311	Median = 1,635 IQR = 297	P = 0.161
Endurance Index	Median = 1.04 IQR = 0.13	Median = 0.98 IQR = 0.10	P = 0.123

3

Effect of Dopaminergic Medication on Endurance



4

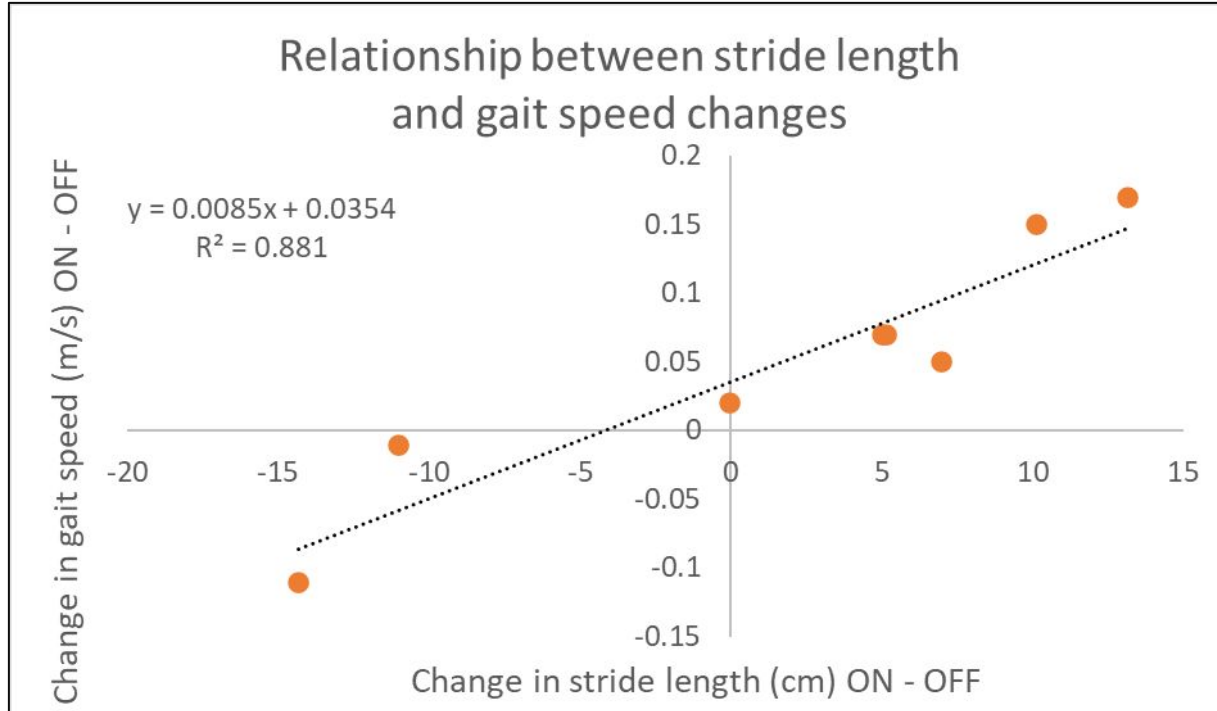
Correlation Between Changes in Oxygen Cost of Walking and Changes in Spatiotemporal Parameters of Gait

Change in gait speed was significantly and strongly associated with change in stride length.

		Correlations					
			COWDiff	GaitSpeedDiff	StrideLengthDiff	CadenceDiff	StepWidthDiff
Spearman's rho	COWDiff	Correlation Coefficient	1.000	-.012	-.071	.190	.595
		Sig. (2-tailed)	.	.978	.867	.651	.120
		N	8	8	8	8	8
	GaitSpeedDiff	Correlation Coefficient	-.012	1.000	.922**	.036	-.204
		Sig. (2-tailed)	.978	.	.001	.933	.629
		N	8	8	8	8	8
	StrideLengthDiff	Correlation Coefficient	-.071	.922**	1.000	-.024	-.048
		Sig. (2-tailed)	.867	.001	.	.955	.911
		N	8	8	8	8	8
	CadenceDiff	Correlation Coefficient	.190	.036	-.024	1.000	-.024
		Sig. (2-tailed)	.651	.933	.955	.	.955
		N	8	8	8	8	8
	StepWidthDiff	Correlation Coefficient	.595	-.204	-.048	-.024	1.000
		Sig. (2-tailed)	.120	.629	.911	.955	.
		N	8	8	8	8	8

** . Correlation is significant at the 0.01 level (2-tailed).

Correlation Between Change in Stride Length and Change in Gait Speed



Discussion

Our results do **not** support our original hypothesis.

These results add to the body of knowledge that dopaminergic medication may not consistently impact spatiotemporal measures of gait in the short-term.

PTs and physicians should not rely on medication alone to provide improvements in gait and walking economy. These results highlight the importance of aerobic exercise and gait training.

Limitations

Small sample size

Majority of participants H&Y 2

Lack of ability to standardize dyskinesia

Questions?