

Background

Introduction

Dual-task walking involves walking while doing a concurrent verbal task. Previous research has shown that those suffering from some form of cognitive impairment are more susceptible to the concurrent task disrupting normal gait.

Long COVID is the lasting cognitive or physical effects persisting from an acute COVID infection. Some of the symptoms include a decrease in physical function through lowered stamina, decreased physical strength, and lowered recoverability. This may be accompanied by cognitive difficulties like word finding, sustained attention, and decreased mental capacity.

Because of the spectrum of symptoms associated with Long COVID, it is important to identify the relationship between subjective self-reported symptoms, performance on a cognitive test, and dual-task walking.

Participants

Participants were recruited with subjective complaints of “brain fog” as a result of their acute COVID infection leading to lasting cognitive complaints.

Correlations Between Measures

Gait Measures:

Stride Length: the distance between the first contact of the heel of one footfall with the next first contact of the same foot (in cm).

Stride time: The time between footfalls of the same foot (in sec).

Stance Centre of Pressure (COP) path efficiency: the efficiency of the line from heel plant to toe off on each foot.

Cadence: The rate of footfalls in steps per minute.

Correlation Table ▼					
		Pearson		Kendall	
		r	p	tau B	p
Stride Length (cm.)	- Stance COP Path Eff. %	0.018	0.866	0.003	0.967
Stride Length (cm.)	- Stride Time (sec.)	-0.179	0.100	0.002	0.973
Stride Length (cm.)	- Cadence (steps/min.)	0.230*	0.033	-0.001	0.985
Stride Length (cm.)	- mind_total	0.069	0.531	-0.017	0.820
Stride Length (cm.)	- msq_poor_memory	0.146	0.179	0.088	0.287
Stride Length (cm.)	- msq_confusion	-0.020	0.858	-0.067	0.407
Stride Length (cm.)	- msq_poor_concentration	-0.038	0.726	-0.029	0.725
Stride Length (cm.)	- msq_poor_physical_coordination	0.083	0.445	0.048	0.547
Stride Length (cm.)	- msq_poor_decision_making	-0.007	0.950	-0.031	0.705
Stride Length (cm.)	- msq_sluttering	0.091	0.403	0.013	0.872
Stride Length (cm.)	- msq_slurred_speech	0.116	0.287	0.093	0.274
Stride Length (cm.)	- msq_learning_disabilities	0.036	0.744	0.026	0.760
Stride Length (cm.)	- moca_total	0.040	0.716	-0.097	0.212
Stance COP Path Eff. %	- Stride Time (sec.)	-0.623***	< .001	-0.477***	< .001
Stance COP Path Eff. %	- Cadence (steps/min.)	0.631***	< .001	0.468***	< .001
Stance COP Path Eff. %	- mind_total	-0.122	0.264	-0.202**	0.007
Stance COP Path Eff. %	- msq_poor_memory	-0.097	0.372	-0.154	0.061
Stance COP Path Eff. %	- msq_confusion	-0.095	0.384	-0.184*	0.022
Stance COP Path Eff. %	- msq_poor_concentration	-0.133	0.224	-0.157	0.057
Stance COP Path Eff. %	- msq_poor_physical_coordination	-0.277**	0.010	-0.196*	0.015
Stance COP Path Eff. %	- msq_poor_decision_making	-0.032	0.767	-0.124	0.125
Stance COP Path Eff. %	- msq_sluttering	-0.109	0.317	-0.204*	0.013
Stance COP Path Eff. %	- msq_slurred_speech	0.077	0.478	-0.048	0.570
Stance COP Path Eff. %	- msq_learning_disabilities	0.014	0.901	-0.172*	0.043
Stance COP Path Eff. %	- moca_total	0.402***	< .001	0.249**	0.001
Stride Time (sec.)	- Cadence (steps/min.)	-0.943***	< .001	-0.965***	< .001
Stride Time (sec.)	- mind_total	0.192	0.077	0.169*	0.024
Stride Time (sec.)	- msq_poor_memory	0.058	0.599	0.064	0.435
Stride Time (sec.)	- msq_confusion	0.215*	0.047	0.174*	0.030
Stride Time (sec.)	- msq_poor_concentration	0.273*	0.011	0.209*	0.011
Stride Time (sec.)	- msq_poor_physical_coordination	0.152	0.163	0.140	0.081
Stride Time (sec.)	- msq_poor_decision_making	0.196	0.071	0.193*	0.017
Stride Time (sec.)	- msq_sluttering	0.127	0.245	0.111	0.174
Stride Time (sec.)	- msq_slurred_speech	0.007	0.949	0.062	0.468
Stride Time (sec.)	- msq_learning_disabilities	0.021	0.849	0.047	0.575
Stride Time (sec.)	- moca_total	-0.290**	0.007	-0.152	0.051
Cadence (steps/min.)	- mind_total	-0.126	0.248	-0.162*	0.030
Cadence (steps/min.)	- msq_poor_memory	-0.024	0.823	-0.050	0.544
Cadence (steps/min.)	- msq_confusion	-0.169	0.119	-0.171*	0.033
Cadence (steps/min.)	- msq_poor_concentration	-0.260*	0.016	-0.218**	0.008
Cadence (steps/min.)	- msq_poor_physical_coordination	-0.087	0.428	-0.142	0.078
Cadence (steps/min.)	- msq_poor_decision_making	-0.137	0.209	-0.188*	0.021
Cadence (steps/min.)	- msq_sluttering	-0.083	0.448	-0.110	0.179
Cadence (steps/min.)	- msq_slurred_speech	0.052	0.634	-0.070	0.414
Cadence (steps/min.)	- msq_learning_disabilities	0.022	0.840	-0.034	0.692
Cadence (steps/min.)	- moca_total	0.283**	0.008	0.138	0.077

Statistics

To firstly determine the extent of gait impairment due to dual-tasking, the dual-task costs were calculated. Dual-task costs for each parameter were calculated as the difference between normal walking and dual-task walking using the formula: ((dual-task gait - normal gait) / normal gait) *100%. The dual-task costs were used for the correlation analyses.

Shapiro-Wilks test for normality of data showed that the data was not normally distributed, and due to this, Kendall Tau B was used as the primary correlational outcome.

MoCA Comparisons

Correlation Table					
		Pearson		Kendall	
		r	p	tau B	p
moca_total	- mind_total	-0.205	0.059	-0.164*	0.039
moca_total	- Stride Length (cm.)	0.040	0.716	-0.097	0.212
moca_total	- Stance COP Path Eff. %	0.402***	< .001	0.249**	0.001
moca_total	- Stride Time (sec.)	-0.290**	0.007	-0.152	0.051
moca_total	- Cadence (steps/min.)	0.283**	0.008	0.138	0.077
moca_total	- msq_poor_memory	-0.236*	0.029	-0.253**	0.004
moca_total	- msq_confusion	-0.259*	0.016	-0.242**	0.004
moca_total	- msq_poor_concentration	-0.180	0.097	-0.179*	0.040
moca_total	- msq_poor_physical_coordination	-0.161	0.138	-0.103	0.229
moca_total	- msq_poor_decision_making	-0.014	0.897	-0.030	0.728
moca_total	- msq_sluttering	-0.020	0.857	-0.051	0.555
moca_total	- msq_slurred_speech	-0.119	0.275	-0.139	0.125
moca_total	- msq_learning_disabilities	-0.185	0.088	-0.202*	0.025

Methods

Subjective Symptoms

Participants filled out the Medical Symptoms Questionnaire (MSQ). This questionnaire asks the participants to score their symptoms on a scale of 0-4 from never having the symptoms, occasionally having the symptom (not severe to severe), and frequently having it (not severe to severe).

POINT SCALE
0 = Never or almost never have the symptom
1 = Occasionally have it, effect is not severe
2 = Occasionally have, effect is severe
3 = Frequently have it, effect is not severe
4 = Frequently have it, effect is severe

MIND

- Poor memory
- Confusion, poor comprehension
- Poor concentration
- Poor physical coordination
- Difficulty in making decisions
- Stuttering or stammering
- Slurred speech
- Learning disabilities

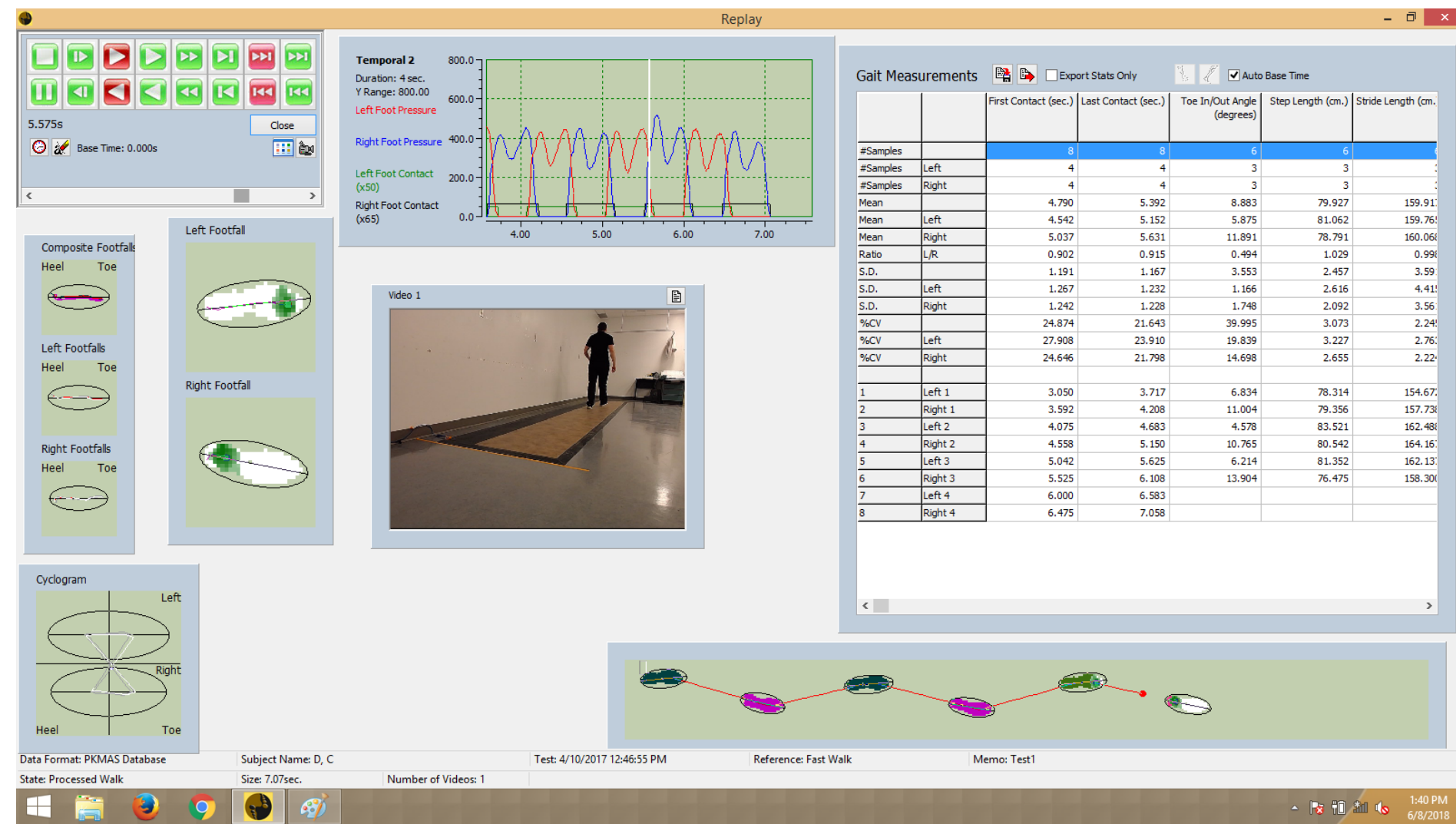
Total 0

Objective Cognitive Assessment

Participants were evaluated cognitively with the Montreal Cognitive Test (MoCA).

Dual-task Walking

Dual-tasking walking required participants saying random letters of the alphabet out loud in time to a metronome set at 60 bpm (1 letter a second). Four gait parameters were compared from normal walking to dual-task walking: stride length (for spatial information), stride time (for temporal), stance centre of pressure (COP) path efficiency (for a measure of stance balance), and cadence (for overall speed).



Discussion

Results

Eighty-six participants completed all tasks. Average “Mind” total score in the MSQ was 14.6 (2-32). The average on the MoCA was 27 (18-30). MSQ “mind” total was correlated with stance COP path efficiency (p: 0.007), stride time (p: 0.024), and MoCA (p: 0.039). Stride time was correlated with: confusion (p: 0.030); concentration (p: 0.011); decision making (p: 0.017). Stance COP path efficiency was correlated with: confusion (p: 0.022); physical coordination (p: 0.015); stuttering (p: 0.013); and learning disabilities (p: 0.043). A participants score on the MoCA was also correlated with their subjective total score on the “mind” section of the MSQ (p: 0.039).

Conclusion

The results from this study indicate that subjective rating of cognitive symptoms due to long COVID correlates with objective scores of cognitive function, as well as to gait dual-tasking deficiencies. This study also shows that participants with self-reported poor concentration, confusion, physical coordination, stuttering, and learning disabilities are more impacted by the dual-task demands.

Limitations

Participants were recruited for their subjectives complaints of post COVID brain fog, but experienced a broad range of cognitive complaints, making it difficult to make generalizations about this population.

Due to the number of comparisons made, the likelihood of a false significant finding increases.

Acknowledgements

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