

The Impact of Cognitive Flexibility and Balance Training on Postural Control in Parkinson’s Disease

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Study Design

Randomized- controlled trial

Purpose and Hypothesis

The purpose of this study is to examine the effects of cognitive, balance, and combined training interventions in individuals with Parkinson’s disease. We hypothesize that cognitive flexibility training will lead to improvements in postural control, and the combination of cognitive and balance training will yield the greatest improvements in both cognitive and motor outcomes.

Background

- PD is a neuroprogressive condition affecting approximately 2% of the population over age 65¹
- Motor symptoms include bradykinesia, resting tremor, rigidity, and postural instability¹
- Nonmotor symptoms can include cognitive impairment including reduction in cognitive flexibility²
- Reserach has shown that incorporating cognitive exercises into treatment for PD may induce better outcomes than standard therapy³

Methods

- Recruitment at local physical therapy clinics, outpatient support groups, and group exercise classes
- 25 participants completed baseline testing
- Assessments (Pre and Post Intervention)
 - Mini-BESTest, Montreal Cognitive Assessment (MoCA), Trail Making Test (TMT) A and B
- Randomly Assigned Intervention Groups (4x/week for 6 weeks)
 - Group 1: Cognitive Flexibility Training
 - Task switching, abstract thinking, selective attention
 - Group 2: Balance Exercises
 - Non-experimental exercises focused on large amplitude multi-joint movements
 - Group 3: Cognitive + Balance Training
- Post testing
 - Mini-BESTest, MoCA, TMT A and B

Cognitive Exercise Example

Connect the objects in an alternating sequence (1→A→2→B→3→C, and so on) as quickly and accurately as possible.

- If an error is made, stop and correct it before continuing.
- Perform the following 3 rounds with breaks in between. **Record the time** it takes you in each round to track your progress!
- For the next slide, pause the video to complete the task and press play when ready to move on!

Balance Exercises



Data Analysis

- Statistical analysis performed using SPSS
- Wilcoxon signed-rank test
 - Pre-post intervention changes within intervention groups
 - Small sample size, non-normal data (TMT-B, TUG)
- Spearman rank-order correlation coefficients (ρ).
 - Baseline correlations between global cognition (MoCA), executive function (Trail Making Test Part B and MoCA visuospatial/executive subscore), and mobility outcomes (MiniBEST, TUG, and TUG-cognitive)

Results

- 13/25 participants completed follow-up testing
- Combined training resulted in significantly higher MiniBEST scores
- Cognitive training resulted in better TMT-B scores, trending towards significance
- Significant baseline correlations
 - Global Cognition (MoCA) and mobility (TUG)
 - Executive function (TMT-B) and mobility (TUG)
 - Visuospatial/executive (MoCA subscore) and dual-task mobility (TUG-cog)

Figures

Table 2. Study Completion/Compliance			
Group	N Baseline	N Completed	Completion Rate
Cognitive (12xx)	9	3	33%
Balance (13xx)	8	4	50%
Combined (14xx)	8	6	75%
Total	25	13	52%

Cognitive, Cognitive Training Only; Balance, Balance Training Only; Combined, Cognitive and Balance Training.

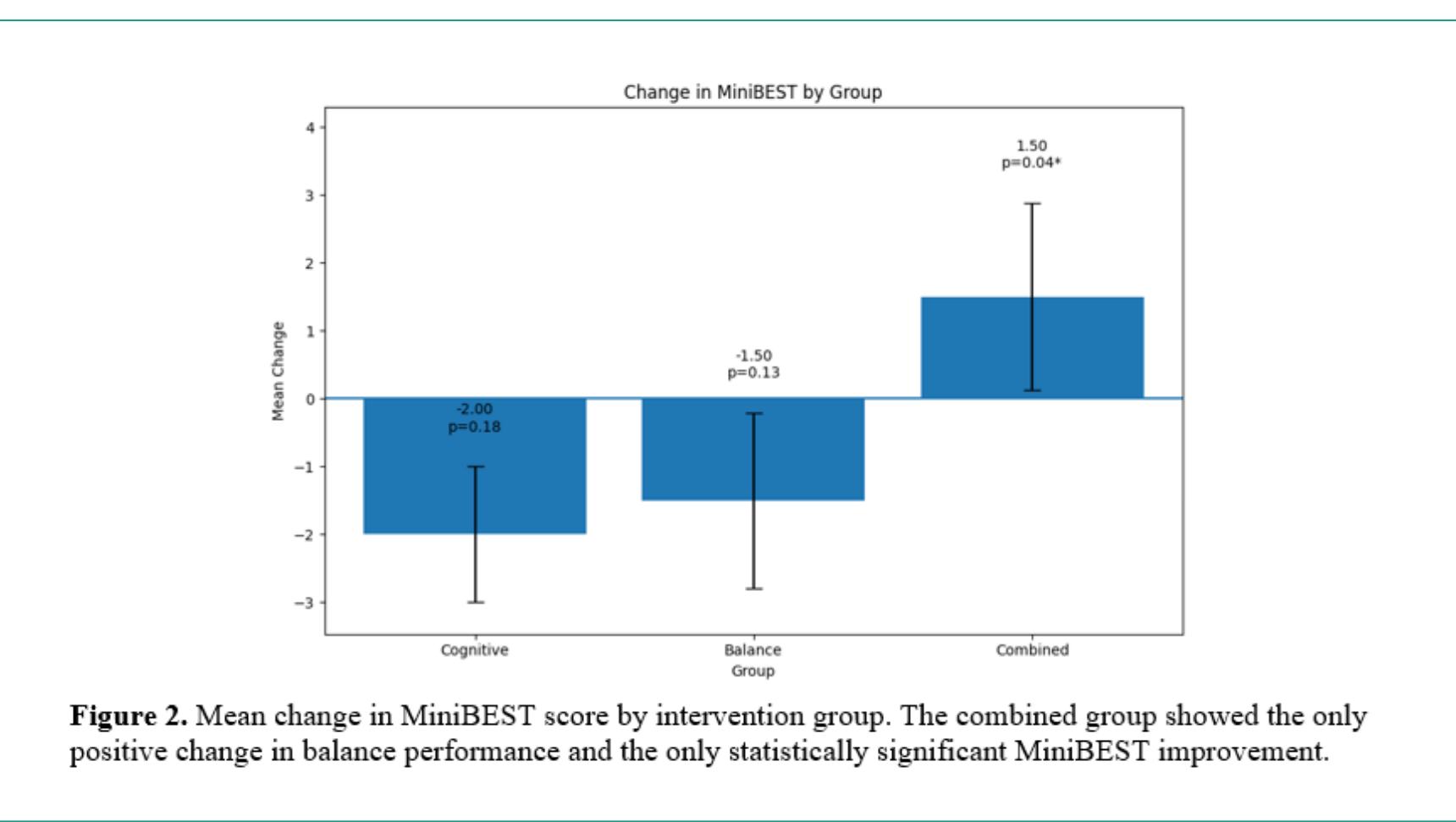


Figure 2. Mean change in MiniBEST score by intervention group. The combined group showed the only positive change in balance performance and the only statistically significant MiniBEST improvement.

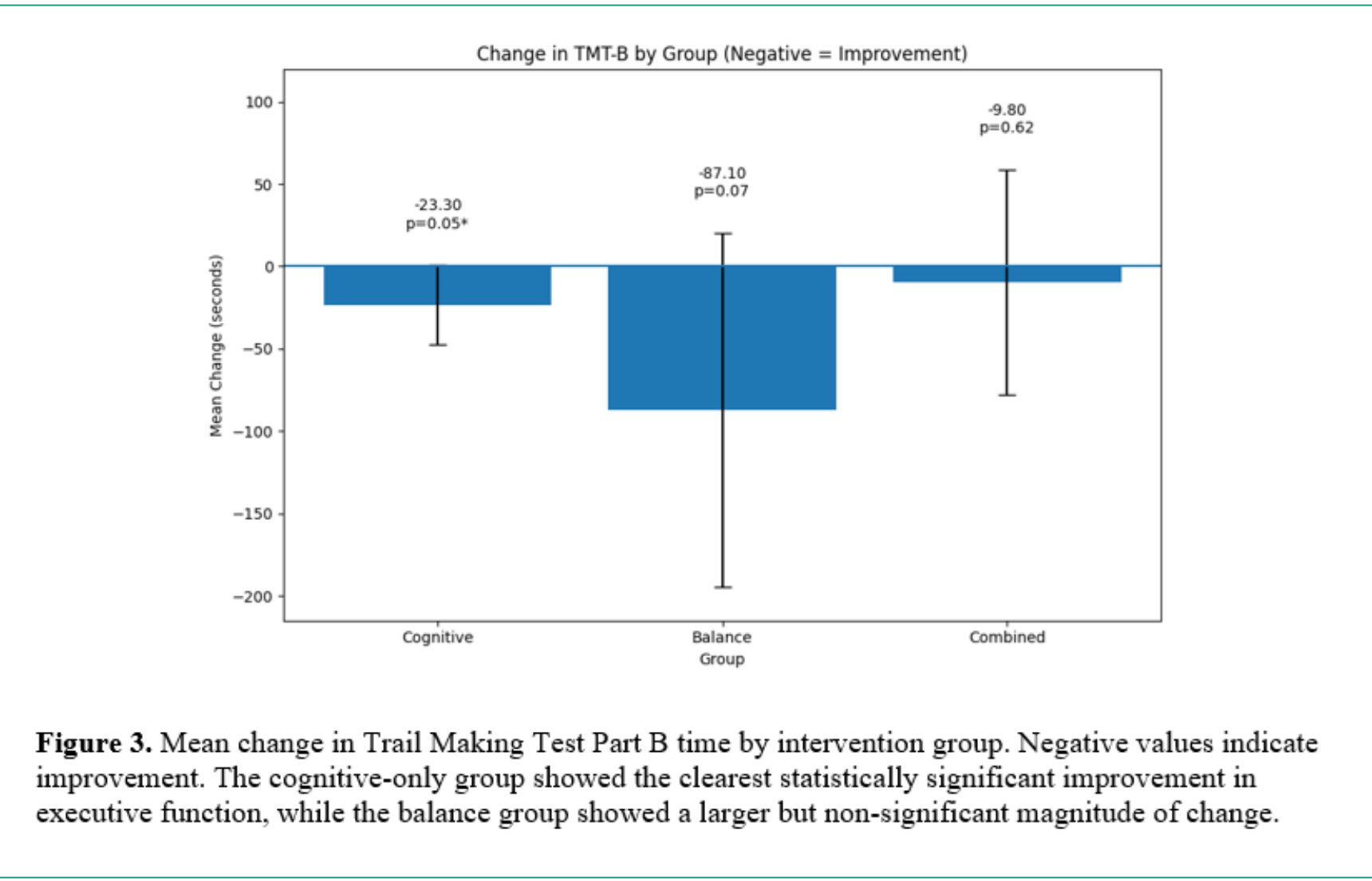


Figure 3. Mean change in Trail Making Test Part B time by intervention group. Negative values indicate improvement. The cognitive-only group showed the clearest statistically significant improvement in executive function, while the balance group showed a larger but non-significant magnitude of change.

Table 4. Baseline Correlation (N=25)	
Variables	Spearman ρ (p-value)
MoCA vs TUG	-0.57 (0.003)**
MoCA vs TUG-cog	-0.46 (0.022)*
MoCA vs MiniBEST	0.32 (0.123)
TMT-B vs TUG	0.45 (0.025)*
TMT-B vs TUG-cog	0.34 (0.099)
TMT-B vs MiniBEST	-0.35 (0.086)
Exec (MoCA subscore) vs TUG-cog	-0.52 (0.011)*

*p < 0.05

**p < 0.005

Conclusion

- These findings suggest domain-specific responses to intervention, with executive and motor outcomes responding differently depending on training focus
 - **Suggests that specificity of training leads to improvement of targeted skills**
- Completion rates were lowest in the cognitive-only group and highest in the combined intervention group
 - Adherence may have been impacted by technology used for cognitive training
 - Perceived value of cognitive training vs. balance training
 - Did the combined group accurately report their training?

Limitations

- Small sample size (N=25)
- Only 33% completion in the cognitive exercise group
- Many participants were already enrolled in group exercise programs or therapies which may have impacted adherence
- Online only access to cognitive exercises

Clinical Relevance and Future Research

- Clinicians should incorporate cognitive training into balance training programs when treating balance issues in those with Parkinson’s disease
- Develop HEPs that promote high levels of adherence and are also highly beneficial
- Future research should include:
 - Effects of current exercise and training levels
 - Longitudinal studies
 - Studies on home exercise follow-through

References

- 1) Opara J, Malecki A, Malecka E, Socha T. Motor assessment in Parkinson’s disease. *Ann Agric Environ Med*. Sep 21 2017;24(3):411-415. doi:10.5604/12321966.1232774
- 2) Radhakrishnan DM, Goyal V. Parkinson's disease: A review. *Neurology India*. 2018;66(Suppl 1):S26-S35. doi:10.4103/0028-3886.226451
- 3) Dajani DR, Uddin LQ. Demystifying cognitive flexibility: Implications for clinical and developmental neuroscience. *Trends Neurosci*. Sep 2015;38(9):571-8. doi:10.1016/j.tins.2015.07.003