

Evaluation of the impact of experimentally induced fatigability on motor and cognitive functions.

Effect of high intensity training on motor and cognitive functions: a pilot randomized control trial

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INTRODUCTION AND AIM OF THE STUDY

Fatigability is one of the most disabling symptoms in People with Multiple Sclerosis (PwMS) often associated with gait, balance, and cognitive deficits. However, its impact on these functions remains underexplored. This project combines a **Cross-Sectional study** aimed at assessing the acute effects of experimentally induced motor fatigability on gait, balance, and cognition in PwMS, and a **Randomised Controlled Trial (RCT)** aimed at assessing the effects of high-intensity multimodal functional training on reducing fatigue and improving motor and cognitive deficits.

METHODS

Healthy Subjects (HS) and PwMS were assessed on balance and cognitive functions before, immediately after, and 30-minute after a Fatiguing Walking Test (FWT) (Figure 1). Participants were asked to walk until exhaustion (Rate of Perceived Exertion, RPE > 18 points) or to stop walking after 30 minutes. Three Inertial Measurement Units (IMUs) were used to assess walking and balance. T-test and ANOVA were used to compare IMUs parameters during the FWT and to assess balance and cognitive differences between HS and PwMS

CROSS-SECTIONAL STUDY

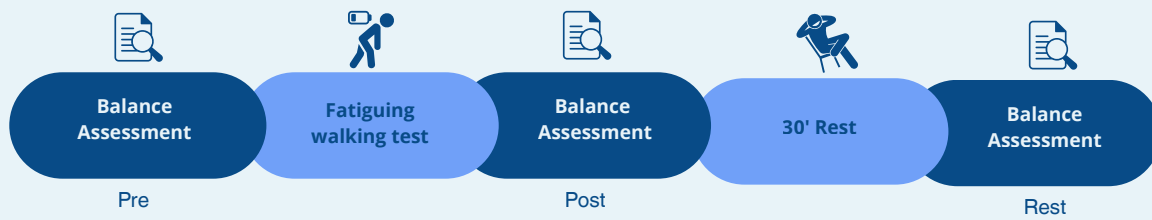


Figure 1: Study design

RESULTS

So far, 96 PwMS with a mean (standard deviation; SD) age of 54.1(10.2) years, 52%F, 48%M, Expanded Disability Status Scale (EDSS) of 3.1(1.2) points and 22 aged- and sex-matched HS were assessed. All HS completed the 30-minute FWT with a mean RPE score of 10.5(2.6) points. Forty-nine% of PwMS completed the 30-minute FWT with a mean RPE score of 14.5(3.7) points, while 51% of PwMS walked about 15.6(6.3) minutes with a mean RPE score of 19.1(1.1) points. (Figure 2)

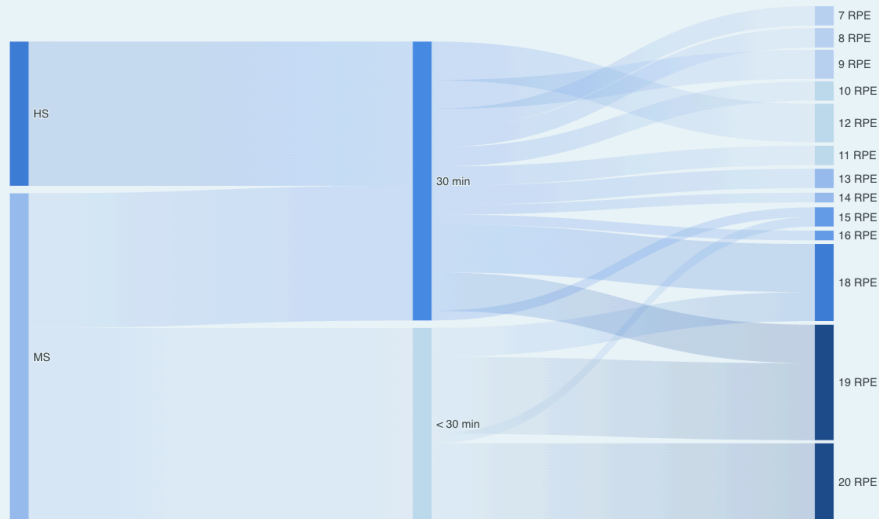


Figure 2: Plot representing time walked and RPE of HS and PwMS

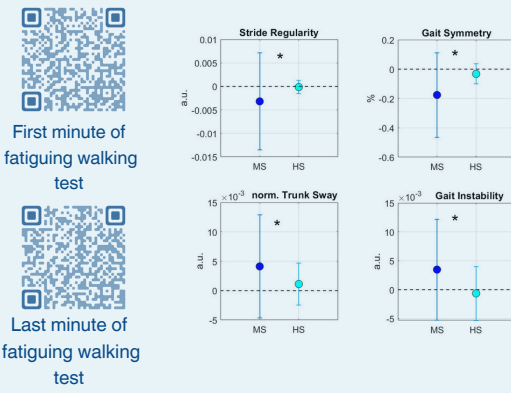


Figure 3: Mean and SD of IMUs walking parameters of PwMS and HS

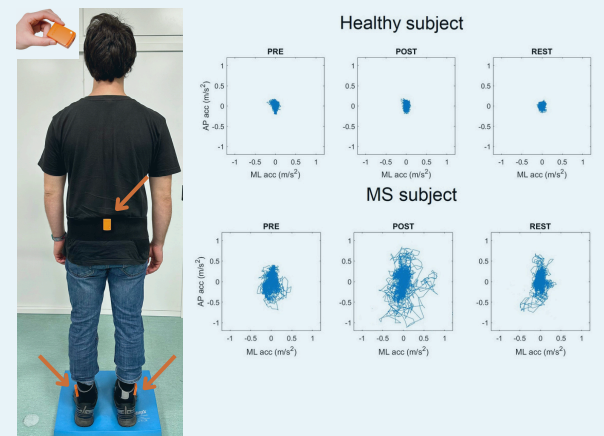


Figure 4: Upright balance with eyes closed on a firm surface in a MS subject and in a HS

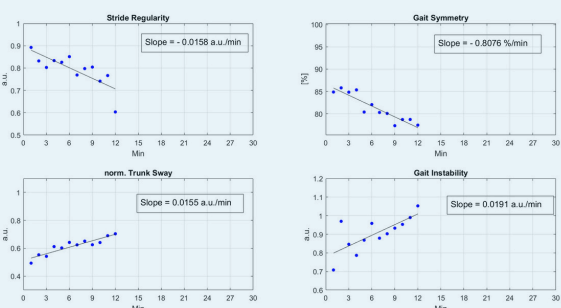


Figure 5A: Walking IMUs parameters during fatiguing walking test in a subject with MS

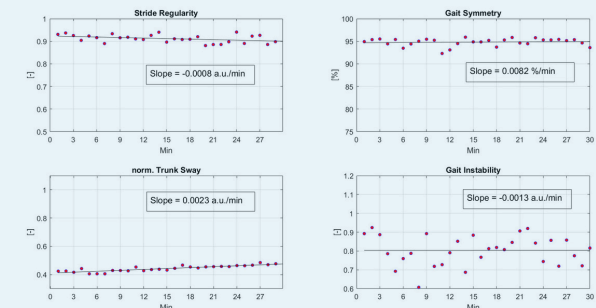


Figure 5B: Walking IMUs parameters during fatiguing walking test in a HS

Figure 3 shows the differences of walking parameters during the FWT between PwMS and HS. PwMS show negative coefficients for stride regularity and gait symmetry, and positive for trunk sway and gait instability over time. HS have near-zero values, indicating stable indices. Figure 4 shows differences in balance between a MS and an HS subject. Figures 5A and 5B show the differences of walking between a person with MS and HS during the FWT.

No changes were reported in Brief International Cognitive Assessment for MS (BICAMS) between PwMS and HS at the three-time points ($p > 0.05$).

METHODS

The experimental group underwent high-intensity multimodal rehabilitation aimed to improve fatigue, balance, and strength (Figure 6). The Control group performed conventional sessions with the same frequency, targeting limitations at the body function and activity levels.

RCT

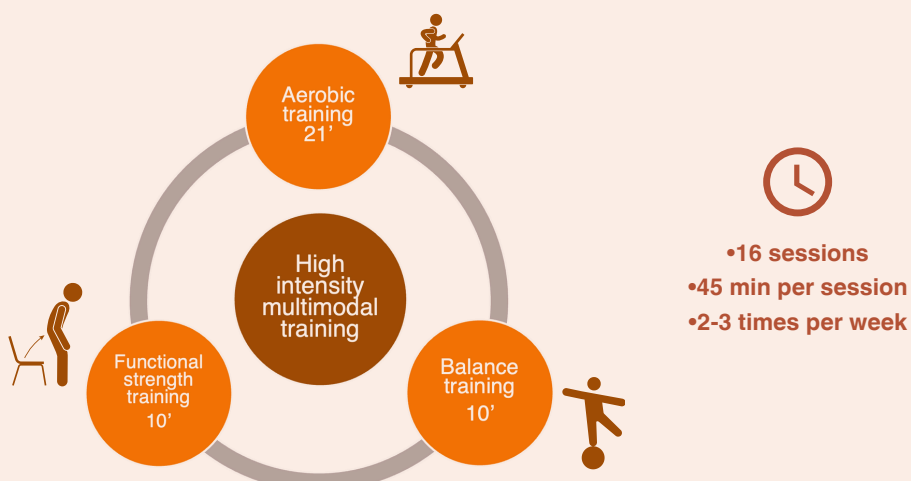


Figure 6: Experimental group intervention

Assessments were conducted at baseline (T0), post-intervention (T1), and 2-month follow-up (T2). The primary outcome was the change in walking velocity (Δvel) during the FWT, calculated as the difference between the mean speed in the first and last minute. Secondary outcomes included the modified Dynamic Gait Index (mDGI), the Modified Fatigue Impact Scale (MFIS), the Multiple Sclerosis Walking Scale-12 (MSWS-12), the the Activities-specific Balance Confidence Scale (ABC), and cognitive performance (BICAMS). We calculated between-group difference using a non-parametric Kruskal-Wallis test.

RESULTS

So far, we recruited 14 out of 30 PwMS, 51.36 (10.92) years old, EDSS of 2.93 (0.87) points, and a disease duration of 14 (11.52) years.

No analysis has been performed yet.

CONCLUSION

Our data show an acute effect of experimentally induced motor fatigability on balance in PwMS, while no effect was observed on cognitive functions. Regarding RCT, the preliminary results seem to indicate improvement only for dynamic balance. We are currently ongoing with the instrumental analysis of the pilot RCT.