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Facilitating Motor **S**kill Learning by Aerobic **T**raining in **P**arkinson's **D**isease II

FaST-PD II

Study Protocol

FaST - PD
Facilitating Motor Skill Learning by
Aerobic Training in Parkinson's Disease

Contact

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Summary

The study is designed to assess the effects of cardiovascular (aerobic) exercise on motor skill learning in Parkinson patients. Specifically, the investigators examine whether a single bout of moderate-intense aerobic exercise, performed immediately following motor skill practice, facilitates motor memory consolidation. In this experimental trial, participants will be randomly allocated to either an intervention group (motor skill practice + aerobic exercise) or control group (motor skill practice + seated rest).

Background

Parkinson's disease (PD) is a progressive neurodegenerative disorder that is characterized by motor control impairments, such as gait disturbances and postural instability. Beneficial effects of exercise are attributed to mechanisms of neuroplasticity, and task-specific motor training (repeated practice of a skill) is consequently considered to be a motor learning process. Importantly, the formation (acquisition) and consolidation of motor memories is impaired in PD compared to healthy individuals of similar age.

Thus, it is crucial to identify strategies to enhance motor learning in people with PD. Recent studies have accumulated evidence to show that acute (single bouts of) cardiovascular exercise can facilitate motor skill learning. However, this evidence is mainly derived from studying healthy individuals. In a first study including PD patients, we recently found improved motor memory consolidation, but not skill acquisition, when practice was preceded by a single bout of cardiovascular exercise.

These results suggest that acute exercise may enhance motor memory formation processes, but could potentially interfere with motor skill acquisition when performed prior to practice. Consequently, the present study investigates whether performing a single bout of cardiovascular exercise immediately following skill practice will enhance motor memory consolidation without affecting skill acquisition in PD.

Aims/Hypothesis

The main question of the study is whether a single bout of moderate-intense aerobic exercise, performed immediately following motor skill practice, facilitates motor memory consolidation in Parkinson Disease.

Hypothesis:

1. An acute cardiovascular exercise bout performed immediately following skill practice leads to increased motor skill consolidation (larger offline gains) after 24 h and 7 days.

Outcome measures

Motor skill learning

A dynamic balance task will be used to assess participants' motor learning performance. The device consists of a 107 x 65 cm wooden platform (stability platform; Lafayette Instrument Europe; Loughborough, United Kingdom), which is mounted on a fulcrum and has a maximum deviation of 15° to either side. Participants are required to stand with both feet on the platform and try to keep the platform as close to the horizontal as possible during a 30 seconds trial. A millisecond timer measures angular displacement from horizontal during each 30 seconds trial. Participants will be secured with a safety harness and instructed to stand in a comfortable position.

Primary outcome measure – Precision

Description: Time in balance (angular displacement ±5° from horizontal) during each 30 seconds trial.

Secondary outcome measure – Variability:

Description: Root mean square error (average angular deviation from horizontal) during each 30 seconds trial.

Memory consolidation (offline learning):

To assess motor skill consolidation (offline learning) primary and secondary outcomes will be calculated as change scores from the final performance (last practice block) during skill practice to skill performance in a 24-hour and 7-day retention test, respectively (Figure 1).

Study design

In an experimental trial, participants will be randomly allocated to one of two groups (Figure 1). Each experimental arm includes i) a pre-examination 2 - 14 days before ii) an acquisition session where the motor skill will be practiced, followed by a retention test iii) 24 ± 2 hours and iv) 7 days later (Figure 1). On acquisition day, the experimental group will perform a single bout of aerobic exercise (cycle ergometer) immediately following motor practice, whereas the control group will rest.

Conditions:

1. Experimental condition: Participants in the experimental group will practice the ***motor learning task*** followed by a single bout of moderate-intensity ***aerobic exercise*** on a cycle ergometer during acquisition day.

2. Control condition: **Participants in the control group will** practice the ***motor learning task*** followed by a ***seated rest*** period during acquisition day.

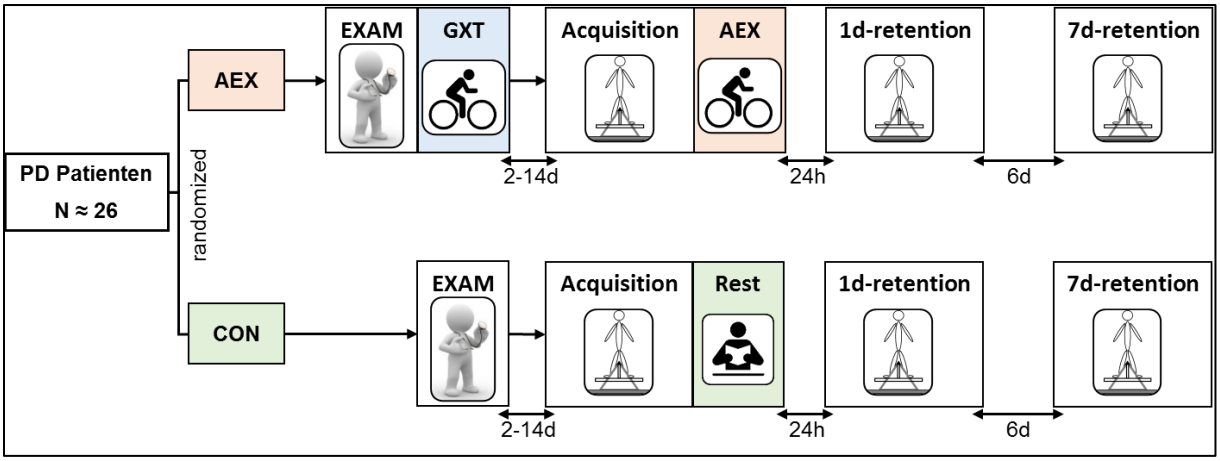

Fig. 1 Study design.

Aerobic exercise bout:

The acute cardiovascular exercise bout comprises a 5-minutes warm-up (intensity will be progressively increased until target intensity), followed by 25 minutes of pedaling at 60–80 rpm and 60% of maximal power output reached in a graded exercise test during pre-examination.

Rest:

The resting phase includes seated rest on a chair for 30 minutes. Participants will be permitted to read during the 30 minutes.

Motor skill practice:

Irrespective of group allocation, participants will follow the identical skill practice routine. On acquisition day, participants will perform a familiarization trial followed by 15 practice trials (30 seconds), clustered into 5 blocks of 3 trials, with 60 seconds rest between trials and 120 sec rest between blocks. 24 hours as well as 7 days later, participants will perform a retention test consisting of one familiarization trial (to account for potential warm-up effects) and one practice block (3 trials) on the stability platform, respectively.

Study population

Inclusion criteria:

Patients are eligible if they have

- a Hoehn and Yahr score of ≤3;
- a score of ≤1 in the UPDRS item 'postural instability';
- are able to stand and walk independently; and
- are not familiar with the motor task.

Exclusion criteria:

Criteria for exclusion are

- higher level of cognitive impairment indicated by a score of <21 in the Montreal Cognitive Assessment (MoCA);
- other clinically relevant neurological, internal or orthopedic conditions besides Parkinsonism that would interfere with the exercise paradigm or motor learning task;
- (musculoskeletal conditions or surgery 1 year before the study enrolment;
- smoking>10 cigarettes/day or drinking>6 cups of coffee/day or >50 g of alcohol (equivalent of two glasses of wine) consumption/day (Winter et al., 2007).

Statistical analysis plan

Power calculation:

Considering data from similar previous experiments, an a priori estimation of the required sample size for the primary analysis was performed using the statistics program G*Power (version 3.1.9.2). Accordingly, to identify a significant interaction effect for offline learning (change from end of skill acquisition to 24h/7-day retention test) with large effect sizes (f=0.58; according to previous studies) with a statistical power of 80% and a significance level of p≤.05, 26 subjects (n=13 per group) need to be included.

Statistical analysis:

The effect of aerobic exercise on motor skill learning will be examined by separate mixed ANOVAs testing for the between-subject factor Condition (aerobic exercise, rest) and the within-subject factor Blocks. Two separate ANOVAs will be performed for 24-hour and 7-day retention, respectively. Specifically, effects of aerobic exercise on offline learning will be analyzed in a 2 (aerobic exercise, rest) x 2 (last practice block during acquisition, first block during 24-hour/ 7-day retention test) model.