# Priming Upper Extremity Motor Practice With Aerobic Exercise (PUMP-Ex): A Preliminary Report on Feasibility and Efficacy

**Emerson Hart, Michelle L. Woodbury, PhD, OTR/L, Ewan Williams, PhD, Chris M. Gregory, PhD, PT, Ryan Ross, PhD**

*Medical University of South Carolina, Charleston, South Carolina, United States*

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*Primary Author and Speaker:* Emerson Hart, hartem@musc.edu

**INTRODUCTION:** Stroke often leaves survivors with lasting motor impairments. An overwhelming majority of stroke survivors exhibit upper extremity (UE) hemiparesis and only a small portion fully recover UE function. Although a multitude of factors contribute to post-stroke recovery, neuroplasticity (i.e., the ability of the brain to adapt) and receiving individualized and progressive rehabilitation are cornerstones of recovery. Duck Duck Punch (DDP) is an interactive video game custom designed to enhance UE movement quality via individualized, progressive movement practice. Aerobic exercise (AEx) training has been shown to enhance global cognition, executive function, and processing speed indicating its ability to enhance brain function. Emerging evidence indicates that AEx acutely enhances neuroplasticity; thus, using AEx as a "primer" for UE rehabilitation (i.e., DDP) may provide an optimal environment in the brain for motor recovery.

**PURPOSE:** To examine: 1) the feasibility of priming DDP with a bout of AEx; and 2) the effect of AEx+DDP on UE impairment and aerobic capacity. Design Six chronic stroke survivors (age: 52±14 years; chronicity: 53±42 months) completed an experimental 6-week intervention (18 sessions).

**METHOD:** Each session consisted of 15 minutes of AEx on a recumbent bike performed at an intensity of 70% heart rate reserve followed by 200 successful target completions during DDP. During each AEx+DDP session, rating of perceived exertion (RPE: Borg 6-20 scale), paretic arm pain (Numerical Pain Rating Scale [NPRS] 0-10), and total time playing DDP were assessed. UE motor impairment was assessed with the Fugl-Meyer Assessment – Upper Extremity (FMA-UE), and aerobic capacity ($\dot{V}$O2peak) was assessed with collection of expired gases during a graded exercise test. FMA-UE and $\dot{V}$O2peak assessments were completed before and after the intervention. Dependent *t*-tests were performed to assess changes in FMA-UE and $\dot{V}$O2peak. Descriptive statistics are reported to describe adherence, pain, and ratings of perceived exertion during the intervention. A Mann-Whitney U test was performed to assess changes in average paretic arm pain.

**RESULTS:** Adherence to the intervention was 100%. Mean time from first treatment session to final treatment session was 46±5 days. All participants were able to complete 15 minutes of AEx each session and played DDP for an average of 23.8±3.4 minutes. Mean RPE was 13.4±1.3 and 13.4±2.4 during AEx and DDP, respectively. Mean pain rating was 0.6±0.9 before each AEx+DDP session and 1.4±1.2 after each AEx+DDP session ($p = .13$). FMA-UE score improved 4.0±4.4 points ($p = .08$) and $\dot{V}$O2peak increased 2.4±1.6 ml/min/kg ($p = .03$).

**CONCLUSIONS:** This preliminary report suggests that priming DDP with AEx is feasible as indicated by adherence rate, time to complete the intervention, and minimal, non-significant, changes in paretic arm pain. Participants reported muscle fatigue as the reason for rating pain levels higher following DDP. There were no reports of increased joint pain and no participants reported increases in baseline pain levels. Although improvements in FMA-UE did not reach statistical significance, such improvements are approaching the minimal clinically important difference. The significant improvements in aerobic capacity indicate that the intervention was aerobically demanding. This novel approach to stroke rehabilitation may promote a perpetual cycle of enhanced functional recovery, reduced disability, and improved overall health.

**IMPACT STATEMENT:** Combining aerobic exercise with upper extremity rehabilitation is a clinically feasible and relevant treatment plan and may simultaneously reduce upper extremity impairment and improve physical capacity in stroke survivors.

## References

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