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EXERKINES AS MEDIATORS OF HEALTH BENEFITS INDUCED BY PHYSICAL EXERCISE

A NEUROMUSCULAR ELECTRICAL STIMULATION CYCLING PROGRAM BOOSTS THE CIRCULATING LEVELS OF BRAIN-DERIVED NEUROTROPHIC FACTOR IN HEALTHY SUBJECTS

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Physical activity and exercise are crucial modifiable factors that enhance cardiovascular, metabolic and brain health (1). Brain-Derived Neurotrophic Factor (BDNF) is a neurotrophin essential for neuroplasticity, regulating neuronal survival, synaptic function, learning, and memory. Considering the prevalent hypothesis that peripheral BDNF response to exercise is primarily correlated with voluntary muscle contraction (2), the current literature has also explored alternative methodologies, such as Neuromuscular Electrical Stimulation (NMES), to induce BDNF release in the absence of exercise (3). Only one study has previously investigated the interaction between exercise and NMES in BDNF response, primarily focusing on stimulating antagonistic muscles during cycling (4). The present study aimed to investigate the combined effect of NMES superimposed in synchrony with agonist muscle contraction during exercise on BDNF release. Nine active men participants (age 38.0±10.6 years, V'O2-peak 48.7 ±5.8 ml· kg-1 ·min-1) were recruited. A 6-week, 2-3 times per week (total of 14 appointments), interval training of 4x5-min at 60% peak power output (PPO) (achieved during an incremental test to exhaustion), interspersed with 3-min recovery at 40% PPO was performed. A novel technology, Adaptive Functional Electrical Stimulation Kinesitherapy (AFESK™), delivered through the VIK8 device (AFESK™ technology, VIK8, VIKTOR S.r.l., Italy), was adopted to trigger NMES in synchrony with voluntary contraction of the lower limb muscles during all the training sessions. Plasma BDNF levels, detected by ELISA assay Kit, were evaluated before (baseline) and after 15 min, 24h, 48h, the first (S1) and the last training session (S14). Non-parametric Friedman test and the Wilcoxon test were used for statistical analyses. Data are presented as mean ± standard deviation. At S1, no significant changes in plasma BDNF levels were observed for any time points. At S14 plasma BDNF levels showed a greater response at 15 min compared to baseline (4.08 ±0.27 and 2.80 ±0.010 ng/ml, respectively; $p<0.001$), compared to 24h (4.08 ±0.27 and 2.75 ±0.12 ng/ml, respectively; $p<0.001$), and compared to 48h (4.08 ±0.27 and 2.77 ± 0.13 ng/ml, respectively; $p<0.001$). After the 6 weeks of training, comparing S1 with S14, plasma BDNF levels showed a higher response at the baseline (S1: 1.95 ±0.07, S14: 2.81 ±0.10 ng/ml; $p<0.05$) and at 15 min (S1: 2.62±0.08, S14: 4.08 ± 0.27 ng/ml; $p<0.05$). No significant changes were observed for the other time points. The results showed that chronic exercise with AFESK™ in synchrony with voluntary muscle contraction during cycling can significantly increase the baseline plasma BDNF levels, suggesting a favorable long-term adaptation. Moreover, it can also increase the transient plasma BDNF response after 15 min from exercise, before returning to the baseline level. This observation suggests that combining cycle exercise with NMES of the agonist muscles may be an effective approach in promoting BDNF release. However, due to the small sample size and the high interindividual variability, more studies are needed to validate these preliminary findings and to fully elucidate the BDNF response in this context.

Keywords: *BDNF, Adaptive Functional Electrical Stimulation, Kinesitherapy (AFESK), exercise, cycling.*