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Changes in brain network organization and brain-behaviour relationships following a 3-month intervention program for individuals with chronic TBI.

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Introduction: We investigated the efficacy of the ABI Wellness interdisciplinary pilot program consisting of: BrainEx cognitive exercises, aerobic exercise, mindfulness meditation, and counseling.

Objectives:

1. To evaluate the changes in EEG brain function in individuals with chronic, mild traumatic brain injury (mTBI) following a 3-month intervention program.
2. To evaluate cognitive and emotional changes and the underlying EEG correlates following the intervention.

Methods: Eight adults between the ages of 22 – 57 years with a history of persistent mTBI (between 1-5 years post injury) and nine healthy age- and sex-matched controls participated in this study. Five minutes of resting state EEG with eyes closed was recorded at baseline and post-intervention. Power spectral density and graph theoretical analysis were used to evaluate the differences from baseline to post-intervention and compared with controls. Cognition was evaluated using the NIH Toolbox Cognitive Battery and the Rey Auditory Verbal Learning Test (RAVLT). We also administered the Generalized Anxiety Disorder Scale and the PHQ-9 Depression scale. All measures were evaluated at baseline and post-intervention in participants with mTBI.

Results: Theta power decreased significantly over three frontal electrodes - Fp2 ($p = 0.018$), F8 ($p = 0.018$), and F10 ($p = 0.025$), and over the temporal T8 electrode ($p = 0.050$), post-intervention and approached the values of the healthy control group. Local clustering coefficient in the area associated with the (R) temporal right brain region also decreased significantly ($p = 0.025$). No significant changes were observed on the NIH Toolbox, although RAVLT learning trials 1-5 score increased from pre- to post-intervention ($p = 0.017$). We found a significant positive correlation between change in the Generalized Anxiety Disorder Scale and change in both Fp2 frontal theta power ($r = .884$) and F10 frontal theta power ($r = .887$) in individuals with mTBI. Change in the PHQ-9 Depression Scale was also significantly correlated with the change in F10 frontal theta power ($r = .770$). Regarding memory, change in RAVLT was correlated with change in clustering coefficient over the temporal right brain region ($r = 0.526$) and F8 frontal theta power ($r = -0.526$).

Conclusions: The results of this pilot study show evidence of change in EEG power, network organization and brain-behaviour relationships following an intensive intervention program. These changes suggest that individuals with chronic mTBI can benefit from targeted intervention and that these changes are associated with brain reorganization that reflect improvements in cognition and reduction in anxiety/depression.