Impact of the COVID-19 pandemic on the prefrontal cortex structure and mental health of PTSD patients

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Introduction: Neuroimaging studies have found that the development of PTSD is linked to structural alterations in brain regions involved in stress and emotion processing, such as the prefrontal cortex. The global COVID-19 pandemic served as a prolonged stressor and induced financial strain, social isolation, and fear, which led to a significant decline in mental health across the population, including increased instances of depression, anxiety, and PTSD. Therefore, it is likely that the COVID-19 pandemic may induce structural brain changes which underlie psychological distress. However, knowledge about the pandemic's impact on the brain remains limited.

Objectives: This current study tested if 1) pandemic-related stress and social isolation worsened mental health and PTSD symptoms, and 2) differential changes of cortical thickness in brain regions responsible for cognitive and emotional regulation underlie PTSD symptoms. Subjects who had undergone structural MRI (sMRI) scanning during and/or before the pandemic, completed a PTSD diagnostic interview during the pandemic, and provided COVID-19 testing records were utilized to assess these objectives.

Methods: 53 subjects from previous neuroimaging research (age=35.2 ± 11.1, F/M=38/15) were utilized for this research effort. Available participants were evaluated via the COVID-related Stress Scales (CSS), Social Interactions (CSI), COVID-related Impact on Mood (CIM), and PTSD Checklist-5 (PCL-5) to assess COVID-related stress, social isolation, depression, and PTSD symptoms. Participants also underwent a PTSD diagnostic interview via the Clinician Administered PTSD Scale-5 (CAPS-5). A brain sMRI scan was taken of each participant to measure cortical thickness post-pandemic. The psychological symptoms and sMRI imaging data were then compared across PTSD and non-PTSD groups, and a longitudinal analysis was conducted to study the effects of PTSD, COVID-19 infection, and pandemic stress on the trajectory of cortical thickness growth in prefrontal regions from before to during the pandemic. Partial correlations were also calculated to test for relationships among psychological symptoms and cortical thicknesses.

Results: 18 subjects were diagnosed with PTSD, and 19 subjects tested positive for COVID-19. The psychological assessments yielded more severe results in PTSD subjects. The post-pandemic cortical regions in left rostral middle frontal (rMFG) and right superior frontal (SFG) cortex were also significantly thicker in PTSD groups. The significant

effects of PTSD, the PTSD*pandemic stress interaction, and the PTSD*COVID infection interaction were demonstrated in the increased thicknesses of the rMFG, inferior frontal (IFG), and frontal pole (FP) cortex for PTSD subjects post-pandemic, whereas non-PTSD subjects demonstrated the opposite change in thickness. Furthermore, positive partial correlations were found between cortical thickness and PTSD symptoms post-pandemic.

Conclusion: The COVID-19 pandemic induced long-lasting stress and social isolation that worsened mental health conditions, including PTSD. The alterations of cortical structure in cognitive and emotional neurocircuitry may strongly contribute to PTSD in a pandemic environment.

