

## Choosing Mountains Over the Beach: Evaluating the Effect of Altitude on Covid Brain Severity and Treatment

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**Abstract :** Chronic Covid syndrome (CCS) is a condition in which individuals who test positive for Covid-19 experience persistent symptoms after recovering from the virus. CCS affects every organ system, including the central nervous system. Neurological "long-haul" symptoms last from a few weeks to several months and include brain fog, chronic fatigue, dyspnea, mood dysregulation, and headaches. Data suggest that 10-30% of individuals testing positive for Covid-19 develop CCS. Current literature indicates a decreased quality of life in persistent symptoms. CCS is a pervasive and pernicious COVID-19 sequelae. More research is needed to understand risk factors, impact, and possible interventions. Research frequently cites cytokine storming as noteworthy etiology in CCS. Cytokine storming is a malfunctional immune response and facilitates multidimensional interconnected physiological responses. The most prominent responses include abnormal blood flow, hypoxia/hypoxemia, inflammation, and endothelial damage. Neurological impairments and pathogenesis in CCS parallel that of traumatic brain injury (TBI). Both exhibit impairments in memory, cognition, mood, sustained attention, and chronic fatigue. Evidence suggests abnormal blood flow, inflammation, and hypoxemia as shared causal factors. Cytokine storming is also typical in mTBI. The shared characteristics in symptoms and etiology suggest potential parallel routes of investigation that allow for better understanding of CCS. Research on the effect of altitude in mTBI varies. Literature finds decreased rates of concussions at higher altitudes. Other studies suggest that at a higher altitude, pre-existing mTBI symptoms are exacerbated. This may mean that in CCS, the geographical location where individuals live and the location where individuals experienced acute Covid-19 symptoms may influence the severity and risk of developing CCS. It also suggests that clinics which treat mTBI patients could also provide benefits for those with CCS. This study aims to examine the relationships between altitude and CCS as a risk factor and investigate the longevity and severity of symptoms in different altitudes. Existing patient data from a concussion clinic using fMRI scans and self-reported symptoms will be used for approximately 30 individuals with CCS symptoms. The association between acclimated altitude and CCS severity will be analyzed. Patients will be classified into low, medium, and high altitude groups and compared for differences on fMRI severity scores and self-reported measures. It is anticipated that individuals living in lower altitudes are at higher risk of developing more severe neuropsychological symptoms in CCS. It is also anticipated that a treatment approach for mTBI will also be beneficial to those with CCS.

**Keywords :** altitude, chronic covid syndrome, concussion, covid brain, EPIC treatment, fMRI, traumatic brain injury

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