

Objectives

Since December 2019, severe acute respiratory syndrome coronavirus (SARS-CoV-2) has caused a worldwide pandemic associated with substantial mortality. It has been subsequently discovered that about 30% of patients with coronavirus disease-19 (COVID-19) may develop neurological complications like anosmia, loss of taste, stroke, encephalopathy, delirium, seizures, meningitis as well as neuropsychological abnormalities. In particular, some very recent case reports suggest that these patients may also present with persistent neuropsychological deficits. However, the long-term neuropsychological and neurophysiological effects of COVID-19 have not yet been systematically studied. Hence, the main aim of this longitudinal project is to determine neuropsychological and neurophysiological sequelae of COVID-19. We would like to investigate whether some individuals who had COVID-19 but are now “coronavirus-free”, may still have cognitive as well as brain abnormalities (determined by electroencephalography). Specifically, since somatic disorders, including respiratory syndrome, in the first line typically affect frontal lobe and its function, we would like to test if COVID-19 survivors will most often present with defective function of the anterior attentional system that in turn will result in psychomotor slowing and fatigue. Further, based on the mechanisms of brain dysfunctions in COVID-19, we would like to determine the possible predictors of long-term neuropsychological effects in this populations. Moreover, this study would be the first to test the hypothesis that in a long-term COVID-19 predominantly impairs functions of the right hemisphere, right frontal lobe in particular (e.g., energizing, monitoring).

Research plan

Participants of this group will be 104 right-handed individuals who recovered from COVID-19. Their initial neuropsychological testing will take place at least 3 months from overcoming their infection. Overall, there are going to be two COVID-19 subgroups: 1) aged 21-60, 2) aged > 60. One hundred and four right-handed participants who did not have COVID-19 will constitute two age-analogous control subgroups. They will be matched for sex and education. To control for comorbidities, control participants will be matched for conditions like hypertension, diabetes and kidney disease.

In all participants, neuropsychological (both standard and experimental), neuroimaging (EEG), clinico-biochemical assessment as well as spirometry test (measuring the amount of air you can breathe out in one second and the total volume of air you can exhale in one forced breath) will take place twice, with the follow-up testing being 12 months from the baseline assessment.

The anterior attentional system will be mainly assessed using experimental set of computerized reaction time tasks that allow to measure three attentional-executive functions: energizing, task setting, and monitoring. While performing these tasks, EEG signal will be recorded, and event-related potentials will be analyzed to longitudinally characterize neuronal underpinning of potential selectively defective anterior attentional-executive system in individuals who recovered from COVID-19. Also, resting state EEG will be used to see which parts of the brain (right vs. left hemisphere, frontal vs. posterior areas) are characterized by changes in cortical arousal. Further, for better understanding of regional and global neurophysiological changes in the COVID-19 patients' brains, the analysis of the biological neural network will be applied.

Research project impact

This interdisciplinary project will allow to test if patients who survived COVID-19, especially older individuals, may still present with defective function of the anterior attentional system as well as changes in cortical arousal and functional connectivity many months after their recovery. Further, by measuring a number of clinical and medical variables, we also intend to investigate the mechanism(s) accounting for possible changes in neuropsychological functioning of people after COVID-19. Moreover, this project will help to learn if COVID-19 may contribute to accelerated aging, decline in attentional processes in particular. If our hypotheses were proven, the results of this study would enable to better understand the impact of COVID-19 on neuropsychological function and fatigue that has often been reported by many COVID survivors. Hence, this research will be an important contribution that may not only influence contemporary clinical neuropsychology and neuroscience but also health and developmental psychology.