

Review

Mind in Crisis: Examining the Cognitive Consequences of the COVID-19 Pandemic

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ABSTRACT

The coronavirus disease-2019 (COVID-19) pandemic devastated the world, leaving in its wake not only physical devastation but also significant psychological trauma. Fear and uncertainty became pervasive, leading to widespread anxiety, depression, and post-traumatic stress disorder. While the pandemic's impact on mental health received significant attention, its effects on cognitive function were overlooked until recently. Studies suggest that the pandemic led to declines in cognitive performance, affecting memory, attention, and executive functioning. The present article explores the cognitive impact of the pandemic, examining the mechanisms through which it affected cognitive function and analyzing its long-term consequences. While the pandemic's immediate impact has waned, its long-term cognitive effects may linger, emphasizing the need to address this overlooked aspect of the pandemic's impact. By understanding the pandemic's cognitive impact and taking steps to mitigate it, individuals and society can better recover and move forward from this unprecedented global crisis.

Keywords

COVID-19 pandemic; Cognitive impact; Psychological trauma; Cognitive resilience; Long-term consequences.

INTRODUCTION

The coronavirus disease-2019 (COVID-19) pandemic has been a global health crisis that has affected people from all walks of life. Beyond the physical health implications, the pandemic has also had significant impacts on mental health^{1,2} and cognitive functioning.^{3,4,5} As the world struggles to cope with the pandemic, it is also important to understand how the virus and its associated stressors have affected our cognitive abilities. The pandemic has disrupted daily routines, led to job losses and financial difficulties, and created a general sense of uncertainty about the future. The pandemic has had a wide-ranging effect on our lives, from social isolation to distant employment.^{6,7,8} These stressors can have negative impacts on cognitive functioning, particularly in areas such as attention, memory, and decision-making. Cognitive psychologists have been investigating how COVID-19 has influenced our cognitive functioning, and their findings indicate that the pandemic has resulted in cognitive alterations in many people. This review will look at the most recent research on how COVID-19 has affected our cognitive capacities as well as possible explanations for these changes.

According to a study conducted by Venkataramani et al⁹ individuals who have recovered from COVID-19 have exhibited transitory or even long-term cognitive damage, many of whom,

including those with deficits in memory, executive functioning, language, processing speed, and attention, have been described in patients with mild illness, and these symptoms are referred to as "brain fog". This cognitive impairment syndrome significantly increases the morbidity of post-COVID-19 symptoms (also known as "long COVID") along with increased rates of anxiety, depression, sleep problems, and fatigue. In another research study by Ollila et al¹⁰ it was found that COVID-19 patients receiving intensive care unit treatment had more severe long-term cognitive damage than patients with less severe acute COVID-19 or non-COVID controls. Particularly in the areas of attention and, for men, executive functions, there was impairment among individuals with more than 12-years of education. According to a meta-analysis,⁵ there is strong evidence that COVID-19 infection causes severe cognitive impairments in patients regardless of their age or pathological stage. Furthermore, there is no conclusive correlation between the degree of neurocognitive deficit and the severity of the infection. Similar findings showed that patients who recovered from COVID-19 had worse general cognition compared to healthy controls up to 7-months post-infection in another meta-analysis.³ According to Zhou et al,¹¹ the recovered COVID-19 patients found that they had lower scores on cognitive tests compared to healthy controls. This was particularly evident in tests of attention, executive function, and memory. These findings suggest that COVID-19

may directly impact cognitive function, which may have long-term consequences. Following this, some of the cognitive aspects that have been affected due to COVID-19 are further discussed:

Impact of COVID-19 on Memory

Memory is a crucial cognitive function that allows us to store and retrieve information. Several studies have found that COVID-19 can cause memory problems. Researchers from the University of Cambridge discovered in an investigation that individuals who had recovered from COVID-19 had less gray matter in specific regions of their brains related to memory processing.¹² A review of the literature¹³ also found that COVID-19 patients commonly experience memory problems. These findings suggest that COVID-19 may have direct effects on the brain's memory-processing regions, causing damage that can lead to memory problems. Alternatively, memory problems may be a result of the psychological stress caused by the pandemic. Stress has been shown to impair memory and cognitive performance in both animal and human studies.¹⁴

Impact of COVID-19 on Attention

Attention is another critical cognitive function that allows us to focus on specific tasks and filter out distractions. COVID-19 can also affect our ability to concentrate and sustain attention. Researchers at the University of Illinois discovered in a review that COVID-19 survivors had slower reaction times, less cognitive flexibility, and attentional lapses.¹⁵ In contrast to healthy controls, a different investigation revealed that COVID-19 patients showed substantial attentional abnormalities.¹¹ The attention deficits seen in COVID-19 patients may be related to the effects of the virus on the brain. COVID-19 can cause inflammation in the brain, which can lead to cognitive impairments.¹⁵ Additionally, the psychological stress of the pandemic can also impair attention and cognitive function.¹⁶

Impact of COVID-19 on Executive Functioning

Executive functioning is a set of cognitive processes that allow us to plan, organize, make decisions, and solve problems.¹⁷ COVID-19 can impact executive functioning as well. Based on a recent study, executive functioning was significantly worse in COVID-19 patients compared to healthy controls.¹⁸ In accordance with the severity of their sickness, COVID-19 patients' executive function scores were reported to be lowered in a different study.¹⁹ The executive function deficits seen in COVID-19 patients may be a result of the virus's effects on the prefrontal cortex, a brain region that is critical for executive functioning. The inflammation caused by the virus can damage this region, leading to impairments in planning, decision-making, and problem-solving.

Impact of COVID-19 on Mood

The COVID-19 pandemic has also been associated with mood changes, which can impact our cognitive functioning. A study²⁰ conducted by researchers at the University of Bristol found that people who experienced symptoms of depression during the

pandemic had reduced cognitive function. Vindegaard et al²¹ has reported that COVID-19 patients who experienced anxiety or depression had greater cognitive deficits compared to those who did not experience these symptoms. These findings suggest that the psychological stress caused by the pandemic, including fear of illness, financial stress, and social isolation, can impact mood and cognitive functioning.²²

Potential mechanisms that affected cognition: From the studies mentioned above, it can be inferred that the COVID-19 pandemic has had a significant impact on our cognitive abilities. The exact mechanisms by which COVID-19 affects cognitive functioning are not yet fully understood. However, several potential explanations have been proposed. One mechanism may be the direct effects of the virus on the brain. COVID-19 can cause inflammation in the brain, which can lead to damage and cognitive impairments. Another mechanism may be the psychological stress caused by the pandemic, which can impact cognitive functioning and cause changes in brain structure and function.^{14,16} One major finding is that stress, anxiety, and depression were prevalent among the general population during the pandemic. In a systematic review and meta-analysis,²³ it was found that the prevalence of these mental health issues has increased since the onset of the pandemic. These conditions have been shown to have negative effects on cognitive function¹⁴ and thus may contribute to cognitive decline during the pandemic.⁴ Multiple studies have reported a significant increase in mental health issues such as stress, anxiety, and depression among the general population during the pandemic. For instance, a large-scale cross-sectional study²⁴ conducted in the United Kingdom during the pandemic found that 57.2% of the participants reported increased anxiety levels, while 64.5% reported increased stress levels. These mental health issues have been shown to have negative effects on cognitive function.¹⁹ For example, it has been found in a study²⁵ that individuals with depression have significant impairments in attention, memory, and executive function compared to healthy controls. Additionally, the social isolation and lack of stimulation caused by the pandemic may also contribute to cognitive changes.²⁰ Also, it has been found that disrupted sleep during the pandemic is associated with cognitive impairments, highlighting the need to address sleep health during this time.²⁶

Another significant finding is the bidirectional association between COVID-19 and psychiatric disorders such as depression and anxiety. A retrospective cohort study of 62,354 COVID-19 cases in the USA found that individuals with COVID-19 were at an increased risk of developing a psychiatric disorder within 90-days of diagnosis.²⁷ On the other hand, individuals with pre-existing psychiatric disorders were found to have an increased risk of contracting COVID-19. These findings suggest that the pandemic may contribute to the development of psychiatric disorders, which may in turn negatively impact cognitive function.

Finally, the pandemic may also have indirect effects on cognitive function through its impact on neurodegenerative diseases. Perry et al²⁸ discussed the concept of "microglial priming", which is a process where microglial cells in the brain become activated in response to inflammation or infection. This process has been shown

to contribute to the development of neurodegenerative diseases, which are associated with cognitive decline. The inflammation and immune activation associated with COVID-19 may contribute to microglial priming, which may increase the risk of neurodegenerative diseases and cognitive decline in the long-term.

CONCLUSION

In summary, the studies reviewed suggest that the COVID-19 pandemic has had a significant impact on our cognitive abilities. The mental health effects of the pandemic, bidirectional associations between COVID-19 and psychiatric disorders, direct effects of COVID-19 on cognitive function, and indirect effects on cognitive function through the impact on neurodegenerative diseases are all potential pathways through which the pandemic may contribute to cognitive decline. Additionally, the COVID-19 infection itself can cause cognitive impairment, particularly in attention, memory, and executive function. Finally, the indirect effects of the pandemic, such as disrupted sleep, reduced physical activity, and increased sedentary behavior can also have negative impacts on cognitive function. Continued research and interventions are needed to mitigate the impact of the pandemic on cognitive function and mental health.

As we move forward, we must address the cognitive health implications of the pandemic. To do so, there are several key areas that researchers, policymakers, and healthcare professionals should focus on.

First, there is a need for continued research on the long-term effects of COVID-19 on cognitive function. Most of the studies to date have focused on the short-term effects of COVID-19 on cognitive function. Longitudinal studies that follow individuals over time will be critical to understanding the lasting impact of COVID-19 on cognitive function.

Second, we need to address the mental health implications of the pandemic. Stress, anxiety, and depression are prevalent during the pandemic, and they have been shown to have negative effects on cognitive function. Addressing the mental health needs of individuals affected by the pandemic should be a priority to mitigate the impact on cognitive function.

Third, we need to address the indirect effects of the pandemic. Disrupted sleep, reduced physical activity, and increased sedentary behavior, among others, can all have negative impacts on cognitive function. Strategies to improve sleep, increase physical activity, and reduce sedentary behavior should be implemented to mitigate the impact of the pandemic on cognitive function.

Finally, we need to address health disparities related to COVID-19. Some populations have been disproportionately affected by the pandemic, including individuals from low-income communities and disadvantaged groups. These populations may be at higher-risk for cognitive impairment related to COVID-19. Addressing health disparities related to COVID-19 is crucial to promoting cognitive health and reducing the overall impact of the pandemic on cognitive function. Public sensitive health programs

need to be developed in order to help prevent many of the previous conditions.

Looking forward, continued research is needed to fully understand the cognitive implications of the pandemic and to develop effective interventions to support cognitive health. Longitudinal studies that follow individuals over time will be particularly valuable in understanding the long-term effects of the pandemic on cognitive function. Additionally, studies that examine the impact of specific interventions, such as cognitive training or mental health support, on cognitive outcomes can help to identify effective strategies for promoting cognitive resilience in the face of ongoing stress and uncertainty.

In conclusion, the COVID-19 pandemic has had significant cognitive impacts, including declines in cognitive performance, increased anxiety and depression, and neurological symptoms. While these impacts are concerning, there is also hope for recovery and mitigation through individual efforts and policy interventions. By promoting healthy behaviors, addressing mental health needs, and supporting cognitive function, we can work to mitigate the negative cognitive effects of the pandemic and promote cognitive resilience in the face of ongoing challenges.

Additionally, policymakers can prioritize funding for research on the cognitive impacts of the pandemic and for the development of interventions to address these impacts. This can include funding for studies exploring the effectiveness of cognitive training programs, mental health support services, and other interventions promoting cognitive resilience and recovery.

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