

Impact of COVID-19 on brain and psychological health, its possible mechanisms, and coping strategies

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Abstract

COVID-19 pandemic has been depicted to possess a robust association with psychological disorders. SARS-CoV-2 is the most recent virus of the coronavirus family and has the potential to bind angiotensin-converting enzyme (ACE) receptor. The receptor is majorly present peripherally, and up to some extent in the brain. Different psychological and neurodegenerative disorders can arise due to peripheral origin of destruction. These triggers could be inflammatory pathways releasing pro-inflammatory cytokines reaching the brain and causing neuroinflammation. In continuation with traditional viruses, SARS-CoV-2 too might lead to brain diseases like meningitis, encephalitis, etc. Besides, several peripheral hormonal changes like cortisol can influence the neurochemical alterations, thereby inflicting mood-related activities and psychological phenomenon. In this regard, health care workers, frontline line workers, family and relatives of COVID-19 patients can be the secondary victims; however, patients with COVID-19 themselves remain the primary ones prone to neurological health problems. Several strategies like socialization, engagement, physical activity, etc. are well-opted measures to get relief from and check the psychiatric disturbances.

1. Introduction

The term COVID-19 was derived from its nature of belonging to the group of Corona Viruses, where D stands for disease, and the pandemic outbreak initiated in the year 2019. The causative virus namely, SARS-CoV-2 originated in the city of Wuhan, China is one of the biggest pandemics after the Spanish flu, almost a century ago. Earlier, it was speculated to be transmitted from bats, yet there is no concrete evidence. This novel virus belongs to the family *Coronaviridae*, which also includes other traditional viruses like SARS and MERS [1, 2]. COVID-19 pandemic has seriously caused global havoc worldwide. Coronaviruses are a group of RNA viruses that cause diseases in mammals and birds. They usually cause respiratory tract infections which can be mild to lethal. In severe cases, it may also lead to death. People across the world have suffered and been through a lot of losses due to this global pandemic. To date, SARS-CoV-2 has been considered one of the most contagious viruses. However, the mortality rate with this virus has been reported around 3–4% globally [3].

Moreover, as a result of this pandemic, numerous other social, economic, and psychological issues have infiltrated the lives of the common population. These issues range from losing jobs, walking miles from different states to reach their families, losing the closest person to us; the world has been through major difficulties. During this period, people came across several terminologies like quarantine, lockdown, curfew, social distancing, and vaccination, etc. For few months people were not allowed to move out of their homes due to the fear of getting infected and to check the spread. Likewise, the pandemic has led to a mental and psychological breakdown in a large number of people worldwide [4].

The financial crisis has led to socioeconomic distress among the masses which has led to a variety of psychological effects in humans. Among these, depression, anxiety, overthinking, feeling low, increased stress level, and insomnia, etc. have been observed. In this regard countries like the USA, India, Brazil,

France, and Russia are among the highest hit by the virus, claiming lakhs of lives and destroying the almost entire world population physically, economically, mentally, and psychologically [4].

2. Epidemiology

In terms of epidemiology, John Hopkins Coronavirus Resource Center has reported that the USA has the highest number of active cases and mortality due to COVID-19. In earlier trends Italy and Iran were leading in cases, however, harsher lockdown halted the cases upto some extent. Moreover, in the current scenario, cases are also steadily rising in most of the European and Latin American countries. However, recovered and controlled cases give a positive outlook in countries like Singapore, China, Taiwan, Sri Lanka, Saudi Arabia, and Germany [5]. So, both natural immunity from infected people and vaccination drive has been proved to be beneficial in checking the super spread. Following Table 1. gives a brief overview of the COVID-related epidemiology.

Table 1
Top 10 countries and COVID-19 cases, deaths, recoveries, tests, and vaccination. Data as per 8th June 2021

(Source: Worldometers.info & WHO).

Data as per 8th June 2021 (Source: Worldometers.info & WHO)					
Countries	Number of cases	Deaths	Recovered	Number of tests	Fully vaccinated
United States of America	34,227,237	612,701	28,177,659	489,733,608	13.9 Cr
India	28,996,949	351,344	27,341,462	368,207,596	4.48 Cr
Brazil	16,985,812	474,614	15,408,401	50,028,915	2.29 Cr
France	5,713,917	110,062	5,425,197	87,363,010	1.26 Cr
Turkey	5,293,627	48,255	5,167,350	55,673,616	1.32 Cr
Russia	5,135,866	124,117	4,743,202	140,600,000	1.32 Cr
United Kingdom	4,522,476	127,841	4,277,098	189,171,158	2.77 Cr
Italy	4,233,698	126,588	3,918,657	67,412,074	1.3 Cr
Argentina	3,977,634	81,946	3,560,148	14,639,773	30.2 Lac
Germany	3,710,341	89,965	3,549,900	61,380,686	1.27 Cr

3. Relation Between Brain And Sars-cov-2

An early report of neurological manifestation, vascular lesions, and impaired consciousness was reported in Wuhan, China, in their hospitalized patients [6]. Coronaviruses have also been reported to develop

neurological manifestations with febrile seizures, convulsions, changes in mental status, and encephalitis [7]. Coronaviruses enter the central nervous system through the olfactory bulb, causing demyelination and inflammation after nasal infection. This entrance gives the coronavirus a neuroinvasive and neurotropic capability which has already been proved in humans [8]. Some COVID-19 patients had been observed with the symptoms of headaches and confusion, more specifically neurological manifestations such as seizure and cerebrovascular problems [9]. Microvascular injury has also been seen in many COVID-19 patients in the olfactory bulb and brain stem cells. Respiratory failure has been revealed in the neuroinvasion of SARS-CoV-2 [8]. Healthy nutrition has become the top priority for COVID-19 patients, which can create lesser damage to the human body. Further, peripheral inflammation can cause long-term consequences in a recovered patient in the forms of neurodegenerative and neuropsychiatric diseases like dementia, psychosis, schizophrenia, and major depressive disorder possibly through a neuroinflammatory mechanism that is associated with an unhealthy diet [10].

In an interesting case, even though there was no direct sign of SARS-CoV-2, still damage was found as an inflammatory reaction probably caused by the coronavirus [11]. Hence, researchers inferred that somehow coronavirus is affecting the brain and damaging the neuronal cells. We hope that these results will help researchers and physicians understand the partial problems of COVID-19 patients so that we can come up with better neurological treatments. In a study of 214 people, it had been seen that 36.4% of patients were showing neurological manifestation. Older people with more severe infection to their respiratory status were more affected by the neurological manifestation which included acute cerebrovascular event, less severe disturbance of consciousness, and skeletal muscle injury [6].

1. Neurological Association of angiotensin-converting enzyme 2 (ACE2) with COVID-19 evident by brain-related findings

ACE2 has been extensively identified as the SARS-CoV-2 receptor and regulator of the renin-angiotensin system including the central nervous system along with lungs, cardiovascular system, gut, kidney, and adipose tissue [12]. Therefore, it can be considered that due to the ubiquitous abundance of ACE-2, the central nervous system can also be infected by the virus [13]. Concerning the mechanism of action, the spike proteins spread over the outer surface of coronavirus are accountable for their binding to the ACE2 receptor followed by entry into the cells. In this context, surface units S1 and S2 assist in strengthening the bond to the ACE2 receptors. This is cooperated by serine protease TMPRSS2 for the priming S proteins [14] (Fig. 1). Besides, there is evidence of the presence of the ACE2 mRNA in the brain from interacting closely with the SARS virus including SARS-CoV-2 in the infected patient [15].

Furthermore, a relationship was drawn between the COVID-19 virus and the brain when the first case of meningitis was revealed in Wuhan, China. The specific SARS-CoV-2 was not detected in the nasopharyngeal swab specimen but the cerebrospinal fluid (CSF) was found to contain it. After that, physicians dealing with COVID-19 patients have been warned about those patients who already had CNS symptoms [16]. Also, in order to find out the relation of COVID-19 with the nervous system, a retrospective study had been done by neuroimaging 185 COVID-19 infected patients. Lesion within the parenchyma

was the most common susceptible abnormality. They concluded that COVID-19 disease had a wide range of inflammatory and vascular effects on both the central nervous system and peripheral nervous system [17].

In another clinical study of 37 patients, one of them had a direct connection with COVID-19 revealed after detecting the RNA of SARS-CoV-2 in the CSF. Besides, 8 neurological patients produced signal abnormalities in the medial temporal lobe, non-confluent multifocal white matter, white matter micro hemorrhage, and hyperintense lesion, revealed after the brain magnetic resonance imaging (MRI) [18]. Additionally, there was a case study series of 27 critically ill patients, among which 11 were COVID-19 positive and went through brain MRI. It was found out that there were the effect of COVID-19 on diffuse leukoencephalopathy, juxtacortical and callosal microhemorrhages through brain imaging by T2 hyperintensity. Among the positive COVID-19 patients, four had diffuse leukoencephalopathy, one had microhaemorrhage in juxtacortical and/or callosal and 6 had both [19].

The above-mentioned effects involve intra-axial abnormality with oval shape microvascular pathology with a greater impact on the corpus callosum and juxtacortical areas. Further, macro-hemorrhagic and ischaemic manifestation with signal abnormalities in the olfactory bulb, leukoencephalopathy, cytotoxin lesion of the corpus callosum, enhancement of parenchyma, and leptomeninges was determined [17]. In a reference center of Paris, Pitié-Salpêtrière Hospital, a large number of patients were observed to possess neurological manifestation. They found out that there is an abnormality in the basal ganglia on analysis of cerebrospinal fluid with the presence of SARS-CoV-2 RNA [18]. The researchers also emphasized the radiographic evidence of strokes in the patients of COVID-19 who were confirmed by RT-PCR. It suggests that radiographic imaging could be the potential tool to minimize mortality and morbidity [20].

5. Neurological Diseases Related To Covid-19

1. **Meningitis:** In the brain, meninges surround it and if a bacteria or virus causes infection to the meninges it results in inflammation. Most of the meningitis-causing bacteria live in the nose and throat without harming the host. But when passing through the nasopharyngeal membrane to enter into the blood it causes problems to the host [21, 22]. Meningitis-causing viruses are enteroviruses, herpesviruses, flaviviruses, mumps, HIV, etc. The epidemiology of meningitis is caused mainly by these viruses [23].

The first case of meningitis/encephalitis associated with SARS-CoV-2 was reported in a retrospective study of 37 COVID-19 patients. Brain imaging of patients revealed some useful information. Abnormal brain structure was found in MRI conducted in 8 distinctive neurological patterns, including the ischaemic infarcts, in patients with severe COVID-19 infection [16].

1. **Encephalitis:** Encephalitis is caused due to the inflammation of brain parenchyma with some neurological dysfunction. Viral encephalitis occurs rarely due to the common infection of herpes

virus infection but can also occur due to some rare viruses like rabies virus infection [24]. So contextually, COVID-19 viral infection can exacerbate the condition.

2. **Leukoencephalopathy:** Leukoencephalopathy is a disorder of white matter of the central nervous system when myelin and associated molecules and genes get mutated or pass through any vascular manifestation, infection, inflammation, toxicity, or any other neoplastic diseases [25]. In a mild case of COVID-19, a patient was found to develop encephalopathy after two months without severe hypoxia. This abnormality was revealed after reporting an excessive amount of white matter at the juxtacortical and subcortical regions of the brain [26].

6. Psychological Impact Of Covid-19

1. **Impact on the body:** The physical and psychological effect of COVID-19 causes changes in the nervous system which regulates the body. From studies, it has been observed that the emotional changes trigger the release of steroidal response hormone called cortisol (secreted from the adrenal cortex). Some scientists have observed that due to the presence of a high amount of cortisol, the immune system gets suppressed. It reduces the number of white blood cells (WBC), interferes with lymphocyte production and some of the immune system regulators. This can additionally aggravate the detrimental effect of COVID-19, as the immune system gets dysregulated.

Furthermore, in a brief account, it has been realized that the COVID-19 leads to constant stimulation of the sympathetic nervous system which leads to a sustained rise in blood sugar level, increase in the breakdown of stored fat, decreased activity of digestive tract, coronary heart problems [27]. In addition, the ongoing pandemic has some psychological impact on the body which induces fear. Due to fear the body's immune system further gets affected. Importantly, the body's key line defense system is the immune system. So, because of long-term fear the body is more prone to be infected with COVID-19 [6].

In clinical studies of COVID-19, T cell subset has been analyzed and it was shown that the CD3 + and CD4 + were decreased, CD8 + increased and CD4+/CD8 + decreased in elder persons leading to a decrease in T cell immune functions. Studies have also demonstrated that the patients admitted in hospitals due to COVID-19 have lymphocytopenia. [28].

1. **Psychological impact on patients:** During this pandemic when people are suspected or detected for COVID-19, some studies have shown most of the patients fall into a psychological state of crisis. They also experience abnormal emotional excitement, shock, anger, denial, and lack of cooperation for their treatment [29]. During the isolation period, some patients had an increased sense of fear for the disease along with anxiety and depression [30].

In some terminally ill patients, the respiratory discomfort and difficulty in expressive behavior caused extreme anxiety followed by panic attacks, despair, and a sense of near-death experiences. A study was conducted on COVID-19 diagnosed patients as well isolated visitors by questionnaire method to analyze their psychological state. The study included 19 individuals. Surprisingly, the results showed that 47.46%

of diagnosed patients and 64.29% of isolated visitors felt anxiety or stress. The number of distressed people was the lowest as in 1.69% in diagnosed patients and 5.36% in visitors. Another study conducted based on the self-rating anxiety scale and self-rating depression scale in 148 COVID-19 patients depicted that 21.63% had an incidence of anxiety and 50% had depression [28, 31].

- 1. Psychological impact on the general public:** The general public who were not even affected by COVID-19 showed symptoms of panic behavior, disappointment, fear, irritability, over-optimism, and sadness. Likewise, people with weak physique thought that they would be affected by COVID-19 easily and they showed greater signs of anxiety, depression, and fear. The fear and anxiety made people even more physically weak leading to headaches and fatigue appearing as symptoms of COVID-19. It further made them psychologically uncomfortable and increased distasteful mood. A study was conducted by using a questionnaire about basic knowledge of COVID-19 in 217 randomly selected individuals. It was a telephone interview that used the anxiety scale (GAD-7) and the patient health questionnaire depressive symptom group scale (PHD-9) for detection of anxiety and depression. The result from the study also revealed that the rate of anxiety detection was about 7.83% and the depression detection rate was 5.53% [32].
- 2. Psychological impact on medical staffs:** During the COVID-19 pandemic medical workers are at risk of being affected anytime by the virus. They suffer many physical changes like decline mood, dyspnea, dizziness along with some psychological changes such as fear, anxiety, depression, etc. Many studies were done on medical staff from different regions. During one study of Wuhan city hospitals, it was found that the average scores of symptoms check list-90 (SCL-90) of the medical staffs in the front line of this pandemic situation has significant differences in somatization, anxiety, and phobia [33]. Another study was done on 224 frontline workers in Wuhan during the prevention and control of the COVID-19 situation. From the study, the data collected revealed 29.9% of the workers had anxiety. Some psychological studies on nurses were also done with similar sort of patterns [34]. Furthermore, the SCL-90 was used to investigate and analyze the psychological status of 41 front-line nurses who were part of the fight against the COVID-19 pandemic. The study asserted that 35 (85.37%) of them had adverse emotional reactions, and 21 (51.22%) showed terrorized emotional reactions. This behavior indicated the psychological stress among the nurses [33]. In another study, based on a self-made general data questionnaire, the self-rating anxiety scale (SAS), self-rating depression scale (SDS), and stress scale (PSS-10) were randomly assigned to frontline nurses in Wuhan. The findings among 44 nurses in Wuhan revealed that 31.8% had anxiety and 45.5% had depression [35].
- 3. Impact on children of healthcare workers:** Children of front-line health workers who are staying with grandparents or distant family members were found to be affected. According to some studies they have been showing signs of separation, anxiety, fear, self-harming tendency, addiction, etc. [36]. Some kids have also lost their parents due to COVID-19 and are staying in foster care. They are suffering from grief, loneliness, adversity and are prone to develop post-traumatic stress disorder. After being exposed to gruesome pictures and news about the disease or deaths on social media platforms, some children were overwhelmed with fear, clinginess, inattention, and irritability [37]. Due

to such development of stress, the level of cortisol and cytokines increased causing health issues in a later stage.

The health-related issues included delay in cognitive development, obesity, asthma, diabetes, sleep disturbance, etc. In some children, the urge to argue, suicidal tendency, and addiction were seen at an extreme level [38]. However, the influence COVID-19 has on people may vary from person to person. A full confirmatory analysis has not yet been done. Future research in this regard will shed light on this direction [39].

- 1. Impact on dementia patients and their caregivers:** Some studies were done on patients with dementia and their caregivers. Being in quarantine, there are rapidly increasing stress-related symptoms in two-third of caregivers. Patients with pre-existing symptoms of irritability, apathy, and anxiety were more prone to develop psychological breakdown rapidly. Sleep disorders and anxiety were under frequently worsening symptoms which increased the neuropsychiatric burden. Symptoms of anxiety and depression were seen in females mostly whereas apathy and irritability were observed in male patients largely. In one of the studies, a structured telephone interview was taken from family or caregivers of patients with DLB (dementia with Lewy bodies), vascular dementia (VD), and frontotemporal dementia (FTD). Eighty-seven memory clinics in Italy regularly followed this to check variation in behavioral and psychological symptoms (BPSD) within 1 month of lockdown declaration. Total 4913 caregivers took part in the study. The results showed that there were 59.6% increased BPSD in patients. 51.9% of patients showed worsening of pre-existing symptoms and in 26% new-onset BPSD occurred [40].
- 2. Impact on pregnant ladies and housewives:** Due to severe hormonal changes in pregnant females, they are more prone to COVID-related psychological effects. The concern about the unborn babies, their care even potentiated the fear [41]. The vaccination process for pregnant ladies is cautioned. Even though the mother's antibodies can be transferred to the fetus, still a large number of parental care restricted the use of certain medicines and vaccines during the pandemic. In addition to that, housewives have also been affected due to COVID-19. This is due to the overburden of additional works, like taking care of online classes for their children. Further, the closure of job-related offices has created more domestic violence cases as homes have turned into the virtual workplace. Work from home has added these problems [42]. A study by questionnaire method was conducted on 599 women receiving assisted pregnancy treatment. The result showed enhanced fear caused by the manifestation of mental state due to COVID-19. Even women from an urban area with educational background and good economic condition have the most serious fear [28]. Importantly, the females' hormones estrogen and progesterone influence immunomodulation and COVID-19 [43].
- 3. Impact on elderly population:** Precisely, the brain of old age people above 65 years are prone to neurodegenerative processes, dementia, and thinking disability. Due to lack of physical activity in COVID-19 induced lockdown, the hippocampal region of the brain shrinks, and hence cognitive dysfunction takes place. Further, food habits like high consumption of glucose and carbohydrate-rich edible items cause brain insulin resistance and hence memory impairment. The reason behind excessive eating is a lack of social engagement and more opportunity and concentration towards

food. Further, old age people get more deprived of social interaction as compared to other age groups. Furthermore, comorbidity and weaker immune system of older individuals makes them more vulnerable to both physical and psychological disorders during COVID-19 pandemic [44].

Furthermore, elderly populations have depicted more severe infection in their respiratory tract and demonstrated neurological manifestations such as an acute cerebrovascular event, less severe disturbance of consciousness, and skeletal muscle injury [6].

4. **Impact on Italian athletes:** Italy was the first European country to come under lockdown because of the COVID-19 pandemic. Earlier, it was among the most affected countries during the COVID-19 pandemic. To measure the impact of COVID-19 on the body, immune system, mental health, different studies were conducted on the Italian population [45]. A study has been done on athletes which showed stress and dysfunctional psychobiosocial state during the crisis. The data taken before the pandemic was compared with data taken after the outbreak. The observation was made in different categories based on gender or competitive level of athletes. It was demonstrated that the COVID-19 crisis increased athletes' perceived stress and dysfunctional psychobiosocial state. Further, it decreased the Functional psychobiosocial state more in women as compared to men [46] (Fig. 2).

Moreover, studies were done taking 76 psychiatrist patients and 109 healthy people in China, and data were maintained. People's symptoms were recorded using the Impact of Event Scale-Revised (IES-R), Anxiety, and Stress Scale (DASS-21), and Insomnia Severity Index (ISI). It was noted that based on IES-R, DASS-21 anxiety, depression, and stress subscale ISI score was higher in psychiatric patients. There was a high rate of insomnia in these patients [47].

7. Possible Molecular Mechanisms Of Psychological Disturbances Associated With Covid-19

1. **Neuroinflammation:** Cytokine and storm are the paramount pathological hallmarks of COVID-19. The pro-inflammatory cytokines like TNF- α , IL-6, and IL-1 β can be generated excessively as a result of coronavirus infections. Further, these cytokines have the potential to cross BBB to reach the brain. It is the major reason for neuroinflammation in COVID-19 patients. In this context, there are widely recognized reports of neuroinflammation-mediated psychological dysregulation [48–50]. The disturbances can arise in the forms of anxiety, depression, and distorted mood. Hence anti-inflammatory drugs can be the potential therapeutic agents for symptomatic relief of COVID-driven psychological abnormalities. Other inflammatory mediators could be chemokines, leukotrienes, histamine, and bradykinin, etc.
2. **Oxidative stress:** The brain is the most demanding organ in terms of oxygen consumption and it accounts for 20%. If there are excessive reactive oxygen species or diminished antioxidant enzymes in the brain, there are possible chances of brain disorders [51]. Further, there are close and direct associations between oxidative stress and the inflammatory pathway, making a connection between COVID-generated neuroinflammation and oxidative stress [52]. Immunosuppression can also arise due to oxidative stress making the immune system compromised to COVID infection [53].

3. **Hormone:** Central nervous system, immune system, and endocrine system are intimately connected and influence each other's activities. In a vice versa case, stressful conditions can also be the trigger of a dysfunctional immune system, making people more prone to COVID-19 induced damage. This rationale causes the pandemic to get even more aggravated [54]. Likewise, the hormone CRH causes the activation of the HPA-axis in response to stress. This is responsible for anxiety and is quite related to immune system dysregulation and viral infection [55]. Additionally, the hormones estrogen and progesterone affect neuroprotection, immunomodulation, and COVID-19 [43].
4. **Cortisol:** Serum cortisol levels have an overwhelmed fluctuations during the COVID-19 pandemic. Both infected and non-infected COVID-19 personalities are prone to this phenomenon. Hence, brain levels of cortisol are also altered. The rationale behind this phenomenon could be stressful and anxious situations in the surroundings. Listening to COVID-related news channels, reading daily newspapers with heightened cases, and the death of a large of people can add the psychological impact. Cortisol can also create the immunosuppressive condition, making the condition of infection even worse [56, 57] (Fig. 3).

8. Strategies During Covid-19 Pandemic To Combat Psychological Deterioration

There are several coping measures as well as combating strategies that can be applied to check the psychological havoc of COVID-19. In this regard, hospitals should start out-patient department (OPD) services that can deal with patients suffering from alcohol withdrawal symptoms (AWS) and can guide them in proper directions. Alcoholics should always be kept in check and they should, if necessary, visit a physician or psychologist for consultation. There should be proper media coverage to aware people about AWS and how to handle extreme situations [58]. The ongoing lockdown has left many lives disturbed and almost everyone went through a break phase. It is important to have a balance in life which can help us to improvise ourselves and keep us away from the negative thoughts and wasting our time unnecessarily.

A reality check in our lives is of utmost importance because it keeps us informed about ourselves, so we can focus on our strengths and work on our weaknesses. Many students used this period as an opportunity to develop their personalities and gain back their confidence through various programs. Yoga can be a powerful tool during the lockdown period as it will bring peace, harmony, and also will help to release the stress and anxiety from within.

Due to the pandemic, many people had developed fear, anxiety because earlier people hardly used to stay for this long at home. By practicing yoga, one can compose oneself from all the inner issues disturbing the mind. Aerobic exercises, which include cycling, dancing, stretching, or even walking have been proved to be significantly reducing anxiety and depression. This will help to provide blood circulation to the brain and under the impact of the hypothalamic-pituitary-adrenal (HPA) axis, this reverses the stress level in the body. It is often observed that aerobic exercise elevates a person's mood to an optimal level. One should

always be an optimist in life. It changes the whole life perspective and it always works out to keep people's minds from getting distracted from negativity and all the anxious thoughts.

There are so many ways to remain optimistic in life: from changing the way we believe and thinking positively to listening to many online motivational videos or even talking to friends or family will help [59]. A narrative review was done by some authors and guidance towards the mental health condition was proposed. The mental healthcare system is more sensitive than other healthcare systems. Several units were set up during the pandemic times which included both psychiatrist and infectious disease specialists. These people were well-trained people who have been trained to handle the people in these situations well so that they can be in check. Daily medical checks were arranged followed by psychological support. The specialist should be trained such that they can diagnose early symptoms of post-traumatic stress disorder. As per the guidelines, family visits were prohibited, video call facilities were organized so that the patients won't feel deserted. Towards the end of treatment, family visits were allowed as the person's feelings can recover faster and can cope up with the outer world again. A regular check-up for these people must be arranged for both the patients and the people living in quarantine as this will keep a check of their mental health and it will definitely avoid the number of suicide cases and even the thought. Also, proper consultation and medication should be provided so that they can be well aware of the situation and won't give up their hopes, and won't feel low. They should be introduced to stress management and strategies which will help them to cope with their normal life again.

It was also observed under a case study that a longer period of quarantine is usually associated with poor psychological health and often leads to cases where it is seen as an adverse effect. Hence, restricting the quarantine period is often seen as a remedial measure. Adapting to the quarantine period with activities that can free the minds of people and also create a positive outlook around them in the period can likely reduce the psychological effect. It is also important to give ample information regarding spreading the infections to the people who are in quarantine. They should be constantly be taken care of and be informed about the importance of being in quarantine. Communication, slight physical exercises are important to reduce boredom and also deviate our mind from isolation. Communication with family, one's friends is really important and also helpful as it creates a positive environment.

As we always say communication is the key to most of the solutions in the world. It can even make us more confident as we shall get fluent with the way we speak to people. From different surveys, it has been proved that one can feel lighter and much more settled when one takes it out from within [60]. The lockdown period has not only affected the adults but also the students as they have been inside their home for months and the situation is not very likely to help them. Earlier, going to school, college, and also being with friends were some of the top activities in every student life's. But due to the current scenario, students have been deprived of those activities and mostly locked inside their homes. This has caused several changes in students' life. Not every student is compatible with their family. This also leads to several changes on a personal level. Several mood swings, anxiety, depression, and also in some case severe insomnia has been observed. It is important for individuals at this age to do some physical activities as it keeps them active and indeed creates a positive atmosphere which helps them to focus on

greater things in life. To gain our focus back is important as many individuals find it difficult to concentrate once their interest has vanished [61].

However, there are some novel techniques applied to target mental alterations. Hence, non-invasive brain stimulation (NIBS) has been tried as an intervention for COVID-19 related mental health deterioration and neurological problems. NIBS is a technique comprising transcranial magnetic stimulation (TMS) and low-intensity transcranial electrical stimulation (tES). The technique also includes transcranial direct current stimulation (tDCS) and transcranial alternating current stimulation (tACS) [62]. These strategies can reverse the psychological health problems upto some extent.

Since the onset of COVID-19 around the globe, and due to the huge spike in the number of cases, the governments had to impose a total shutdown almost throughout the world. It became a big struggle for the alcoholics as most of the liquor shops had to be shut down too. This led to alcohol withdrawal symptoms (AWS) in alcoholics. As per data, due to the unavailability of alcohol and people suffering from AWS, there were 23 cases of suicide and several attempts of suicide. These people were mainly from the urban populations with more proportionality of men. As time passed, the number of suicide and also the attempts to commit suicide increased all across the globe. Some people were so desperate that they even drank sanitizers to fulfill their urge of consuming alcohol. There were many governments funded mass media campaigns to minimize the intake of alcohol and to stop the attempts for suicide (Fig. 4).

9. Conclusion

In a nutshell, this review can be concluded that COVID-19 has explicitly deteriorated the psychological well-being of human beings. This pandemic has impacted almost an entire line of populations ranging from healthcare workers to housewives, resulting in dysregulated mental health through some specific inflammatory or hormonal mechanisms. However, a large number of control strategies have been recommended to normalize life.

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Authors' contributions

FZS had the idea for the article, created figures and table, DS and AC did literature search, AA reviewed and edited the manuscript. However, all the authors contribute almost equally in writing the manuscript.

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Figures

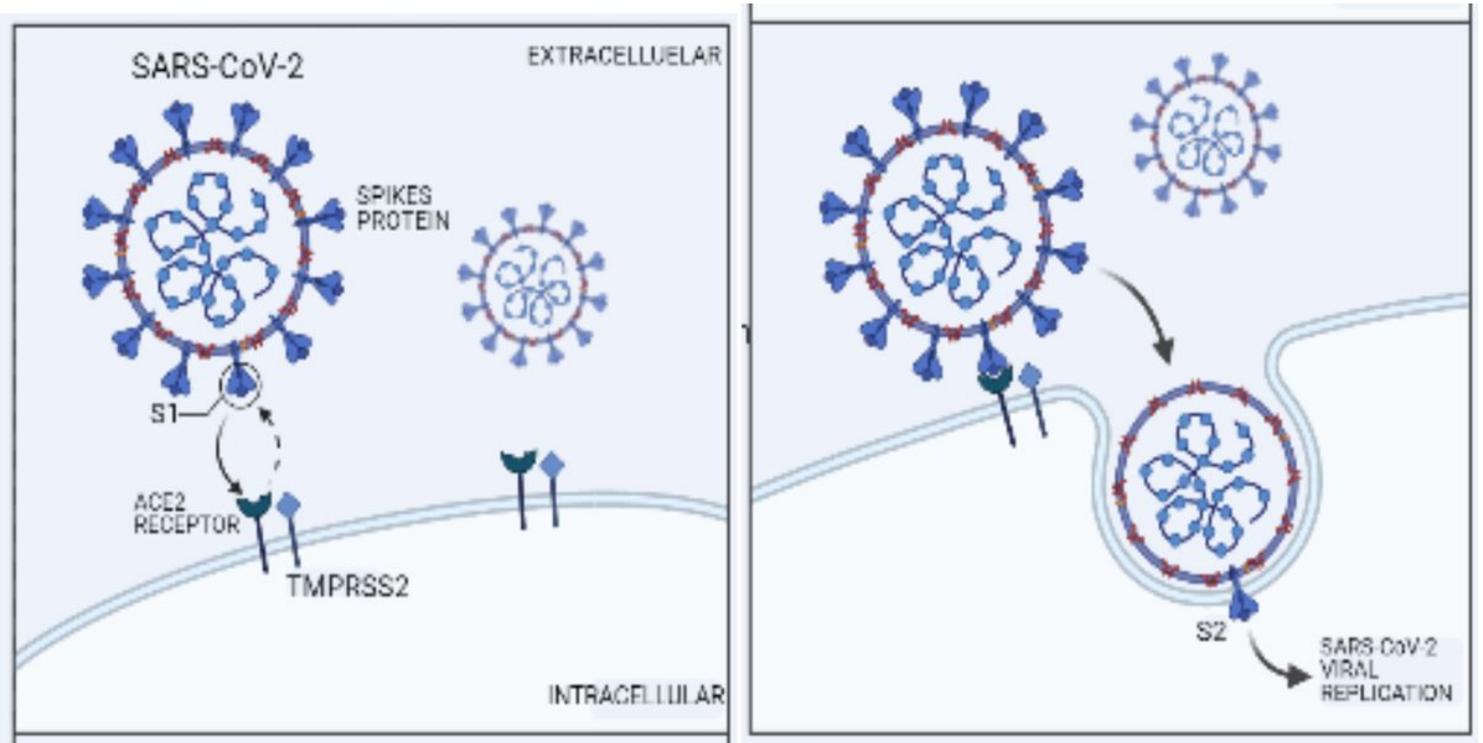


Figure 1

Binding of SARS-COV-2 with ACE2 receptor. The figure was created in Biorender.com

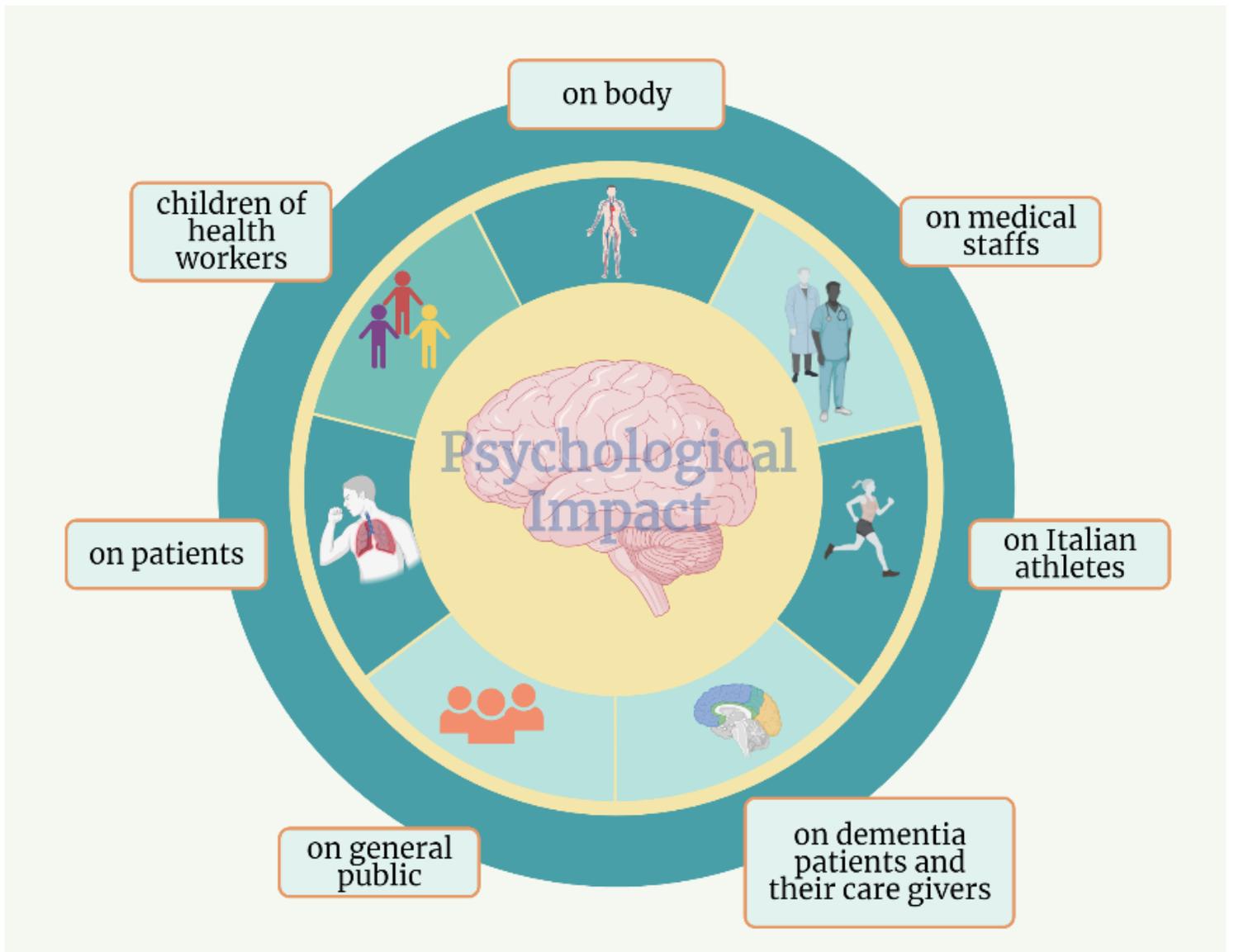


Figure 2

Overview of the impacts of COVID-19

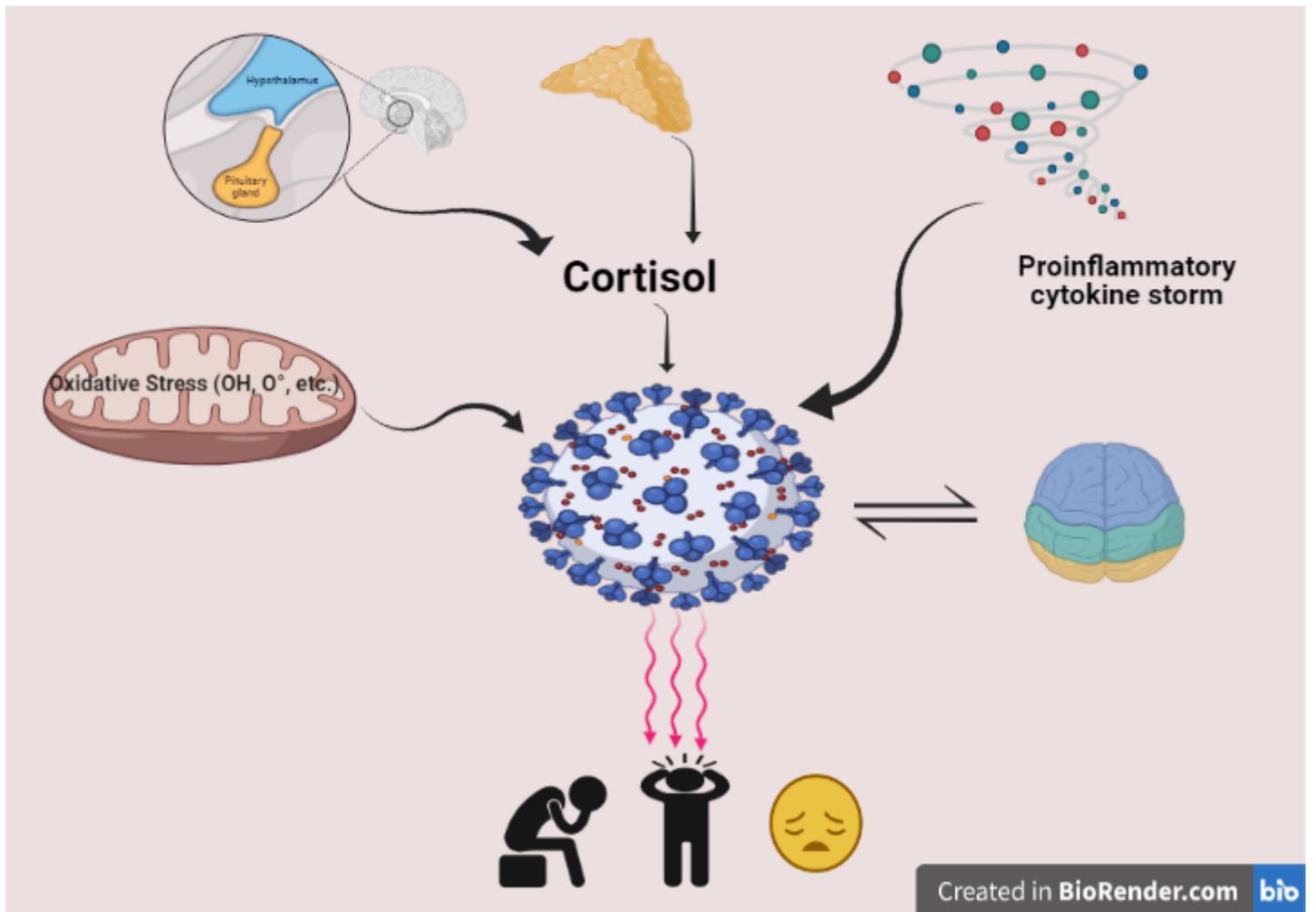


Figure 3

A brief overview of molecular mechanisms involved in COVID-19 induced psychological disturbances

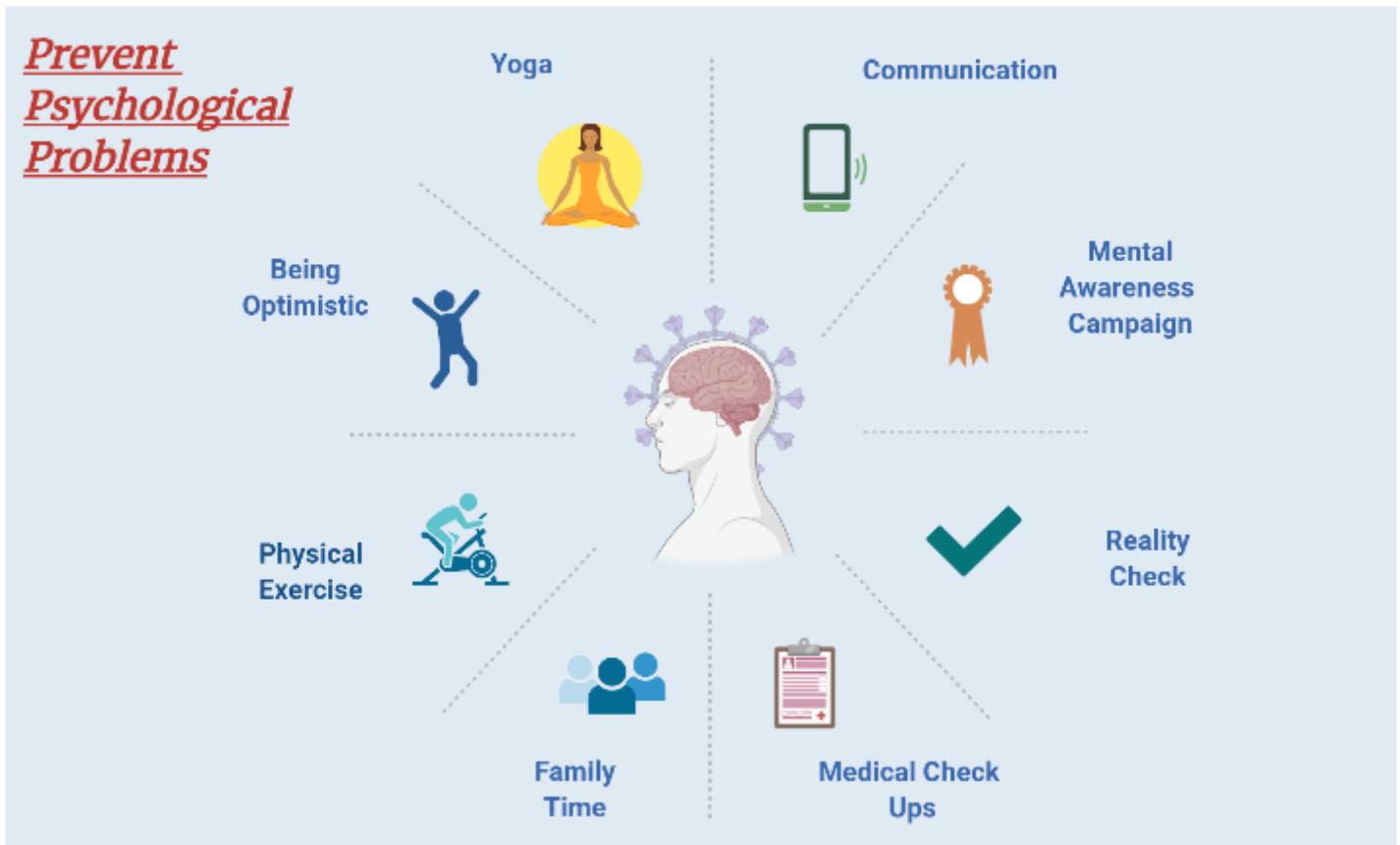


Figure 4

Schematic illustration of strategies to tackle psychological problems