

A STUDY ON NEUROPSYCHIATRIC IMPACTS OF SARS- COV-2 PANDEMIC

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Abstract:

The Corona Virus disease, better distinguished as Covid-19, led to a global pandemic that has affected our lives in ways more than one. The fear of getting infected, unexpected lockdowns, implementation of the work from home policy and online classes is affecting the psychological well-being of every one of us. Following this context, this study aims to evaluate the mental well-being of the adult population dwelling in Mumbai: the area which is worst hit by the pandemic in India. This study was conducted with the help of a survey. As a consequence of this pandemic, exponential growth in cases of anxiety, depression and several other neurological symptoms among individuals have been observed. The authors also discuss the other Neurological manifestations of the SARS-CoV-2 virus. These findings scrupulously emphasize the importance of monitoring the mental well-being of individuals and providing necessary psychological intervention and other coping methods during these pandemic led times.

Key words: SARS-CoV-2, neuroscience, depression, anxiety, pandemic.

Introduction:

We have been amidst a pandemic since the start of 2020. Since its outbreak in Wuhan, China in December 2019, SARS-CoV-2 has fast spread like a pandemic, designated as Covid-19 by the World Health Organisation (WHO) on 11 February 2020.² Just like the previously reported zoonotic pathogens like SARS-CoV and MERS-CoV, the novel coronavirus SARS-CoV-2, is a β -corona virus causing severe respiratory diseases in humans.² On 30 January 2020, the WHO declared this outbreak as a public health emergency of global concern.³ The emergence of

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SARS-CoV-2 has shown many implications on the population. Cough, fever, and shortness of breath have been reported to be the most common symptoms of Covid-19.² A recent study has documented that apart from the systemic and respiratory symptoms, 36.4% of patients with the Covid-19 developed neurological symptoms.⁴ This disease has taken a toll on the mental health of Covid-19 patients, their family members, frontline health workers, and even young students alike. The lifestyle change, the work from home policy, and studying on screens all contribute to the much sedentary life we all live in. This unprecedented change in daily life, increasing viral cases, elevating death tolls, fear of getting infected, unexpected lockdowns, etc. are affecting the psychological well-being of people worldwide. There has been a surge in the cases of anxiety, depression, and several other neurological symptoms among individuals. In a bid to overcome this outbreak, several kinds of research are being conducted in various aspects of Covid-19. This study aims to assess the extent to which the mental health of college students and other service holders is affected in Mumbai, India.

Materials and methods:

Participants and Survey Design

The cross-sectional study was conducted online for two days: 10 September 2020 and 11 September 2020, to audit the impact of the Covid-19 pandemic on the adult populations (≥ 18 years) living in Mumbai. Around 794 people participated in this study. Google forms (Google LLC, California, United States) was used to design and create a survey that was hosted by a unique web link. The survey was developed under the guidance of Prof. Kyle J. Meyers and Prof. Neha S. Kapadia, Department of Chemistry at St. Xavier's College (Autonomous), Mumbai. The survey highlighted that the participation was voluntary and all the information collected would be kept confidential. Respondents were asked about their:

- 1) demographic information
- 2) Traumatic stress symptoms
- 3) Depression and anxiety
- 4) Study/work from the home situation and the different parameters associated with the same causing visual and auditory stress and strain.
- 5) Different de-stressing routines followed.

Respondents had to answer "Yes/No" - styled dichotomous questions where close-ended questions can give conclusions quickly and efficiently, and a few self-reporting questions in order to complete the survey. The test was distributed to students, teachers and professors, and many other service holders in various areas through electronic means like e-mail and other social media groups. Succinctly we calculated the frequency of responses concerning different categories.

Measures

Respondents were asked to answer the 18 items questionnaire, examining the different psychometric areas and their mental status during the Covid-19 outbreak. These questions were asked using a 3-point ordinal scale: "Yes", "No", and "Maybe". To assess the stressors associated

with the pandemic and the different de-stressing routines followed by the subjects, self-report measures were used. The questionnaire is listed in Table 1.

Table 1: Structure of the questionnaire.

SECTION 1: Demographic Information

1. What is your age?
 2. What is your gender?
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SECTION 2: Traumatic stress symptoms

3. When it comes to Covid-19 do you feel any kind of stress?
 4. Do you think scrolling through social media pages and reading blogs on Covid-19 make you feel stressed?
 5. What are the major reasons for the stress?
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SECTION 3: Depression and Anxiety

1. Over the last few months, approximately how often have you been bothered by the following problems.
 1. Feeling nervous or anxious
 2. Not being able to stop or control worrying
 3. Feeling down, depressed or hopeless
 4. Little interest in doing things
 2. Have you been through any kind of depressive episode throughout the entire lockdown period?
 3. What changes did you notice in yourself during the depressive episode?
 4. Did you seek any medical help?
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SECTION 4: Study/work from home situation

1. Apart from mental stress and anxiety have you faced any other problems mentioned below.
 - A. Eyestrain
 - B. Auditory strain
 - C. Headaches
 - D. Migraine
 - E. Dizziness

2. What do you think about the work/study from the home situation?
3. Does work/ study from home make you worry?
4. How is your screen time affected? Increased by
 - A. 2 times
 - B. 4 times
 - C. Even more
 - D. Has not affected me at all.
5. For how long do you plug in your earphones/ headphones per day?
6. Do you think that excessive use of earphones affects your hearing ability?
7. How does using earphones/ headphones for a long time affect you?

SECTION 5: Different De-stressing routines followed

1. What kind of activities did you perform to calm your mind and de-stress yourself?
 2. Do you think these activities helped you understand things in a better way?
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Results from responses

From 794 responses collected, some invalid and random responses were deleted and a total of 601 valid responses were analyzed for this study. Out of the total participants that answered the questionnaire, 60.89% were women, 38.76% were men and a few others did not wish to specify their gender. The mean age of the study participants was 31.4 years. The demographic information of the respondents is given in Table 2.

Variable	Number of respondents, (%)
Gender	
1. Male	233, (38.76%)
2. Female	366, (60.89%)
3. Other	2, (0.33%)
Age groups	
1. 18- 25	335, (55.74%)
2. 25- 40	116, (19.30%)
3. 40- 60	135, (22.46%)
4. 60 and above	5, (0.83%)

Prevalence of stress and stress-associated factors.

From the evaluated psychiatric symptoms frequency for all the respondents, per general areas, a higher proportion of people that is 59.23% reported excessive levels of stress, while 15.80% did not stress out with the outbreak of Covid-19 pandemic. About 24.95% respondents reported that they were not sure about the prevalence of stress and stress-associated symptoms. The stressors associated with SARS-CoV-2 have the potential to disrupt the normal functioning of an individual. According to the responses collected, different types of stressors were identified. Figure 1 indicates the most notable stressors evaluated.

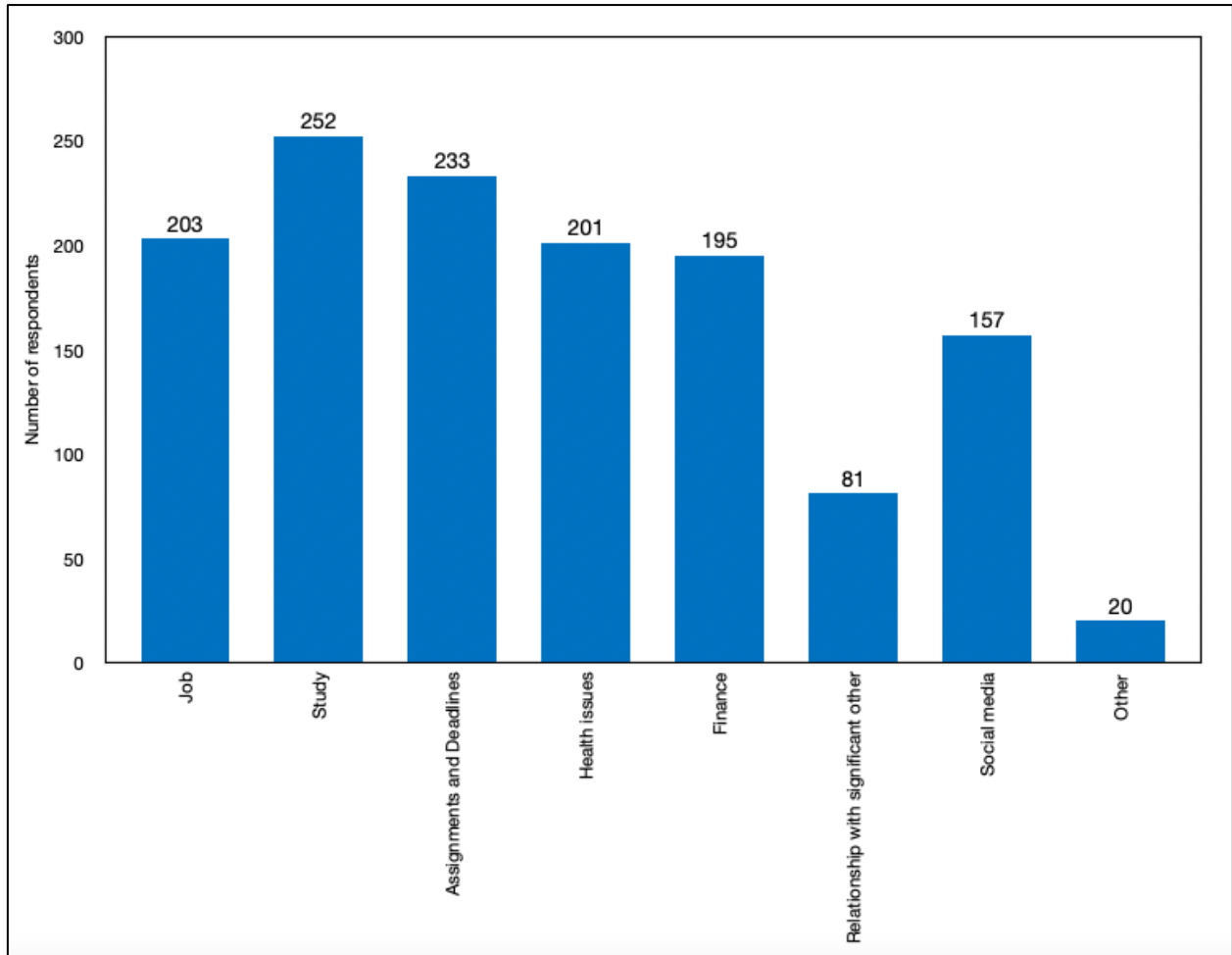


Figure 1: Major reasons for stress

Results for such high levels of stress proved to be highly dependent upon categories like Job, education, health issues, socio-economic factors, and social media and news. A large number of people have noted the maintenance of health as their major stressor. This can be intensified if families need separation, by the uncertainty of disease progression, an insufficient supply of essentials, financial losses, increased perception of risk, which usually get magnified by misinformation and improper communications through media in the early phase of a pandemic.

Evaluation of Depression and Anxiety

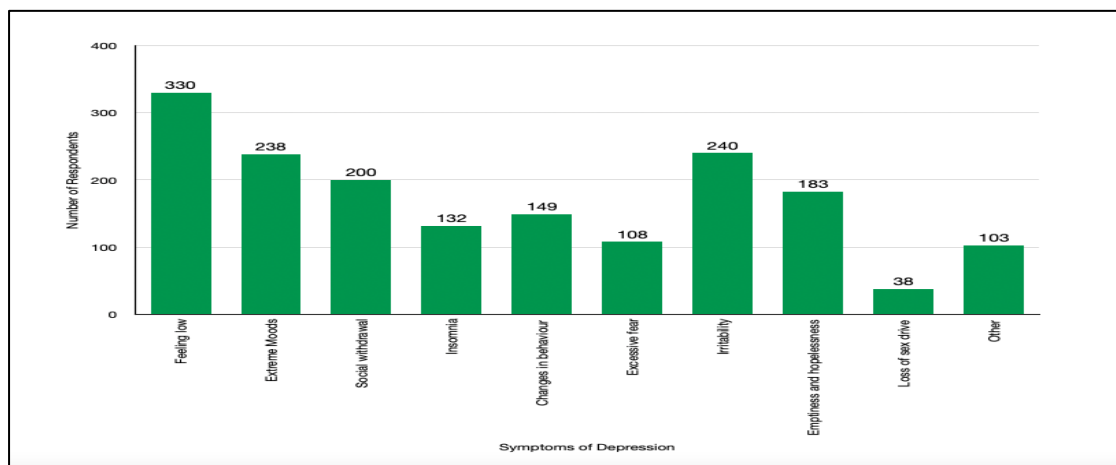
A few questions were framed to assess the levels of anxiety and depression in the people related to Covid-19. The respondents were asked to report how often they saw themselves facing the symptoms of depression and anxiety. Table 3 shows the responses of the participants. It is seen that a large number of people reported finding themselves struggling with the symptoms of anxiety and depression for several days while a midget number of participants did not feel depressed and worried about the Covid-19 situation.

Table 3: A comparative study of the responses

	Depressive symptoms		Anxiety-related symptoms	
	Little interest in doing things	Feeling low and hopeless	Not being able to stop or worrying	Feeling nervous or anxious
Not at all	124	187	151	158
More than half of the days	108	82	108	91
Several days	223	253	236	248
Almost everyday	146	79	106	104

The respondents were also asked to select the relevant changes they noticed in themselves during the depressive episode if at all they faced any. Figure 2 shows us the most commonly noticed changes in the respondents.

Figure 2: Changes observed in the participants

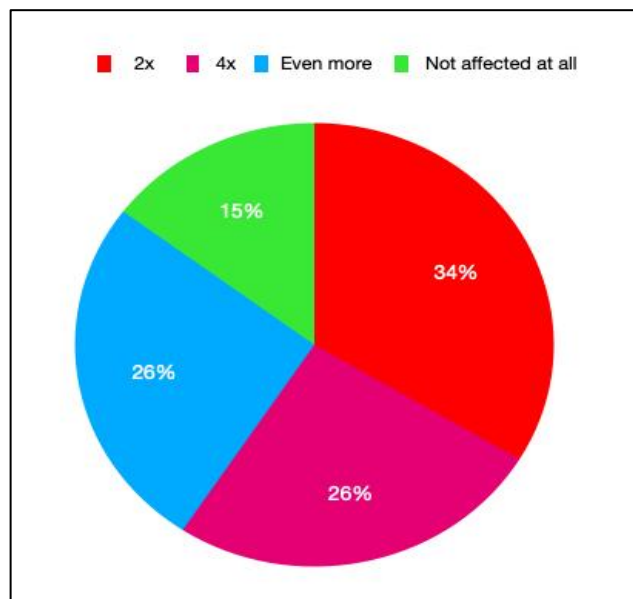


Even though many people reported undergoing depression, surprisingly not many of them sought any medical help (72.37%).

The work/study from home situation

The forced quarantine, nationwide lockdowns and a sudden change in lifestyle and the work from the home policy have strikingly increased the concerns related to the visual and auditory system of the body. Among the computer workers and now the students studying virtually, visual complaints and neck pain are very common, but apart from this 52.57% of participants reported psychological stress and anxiety while working/studying online. This could be traced down to various reasons like working more than usual, meeting deadlines, completion of tasks/assignments, connectivity issues etc. When asked about the current work from home situation, 62.56% of respondents agreed that it is worse than the traditional methods. Some 32.61% of participants reported it is better while 16.47% others said that it is more or less similar to working offline and on-site. Working/studying online has also increased the screen time and time we plug in earphones/headphones. Figure 3 shows the changes in screen time.

Figure 3: Changes in screen time (Increase)



The results above show clearly that for 34% of people, the screen time was increased by two times, for another 26% of people who have experienced a jump by four times in their screen time. Out of the remaining participants, 26% have said that they have experienced their screen time to be increased by over four times whereas 15% so people have just not observed any change in their usage of electronic devices affecting their daily screen on time. This drastic increase in the usage of screen time has affected the health of individuals causing headaches and even myopia, also known as nearsightedness in some cases. Some participants have reported that their screen time has increased and that they have trouble while reading. The increased screen time has also limited the time for outdoor activities, resulting in an unbalanced and sedentary routine causing other health-related problems.

The excessive use of earphones has also affected the auditory system. Many respondents logged in the symptoms like ear pain, dizziness, ear infection etc. Figure 4 highlights the symptoms of auditory stress amongst the respondents.

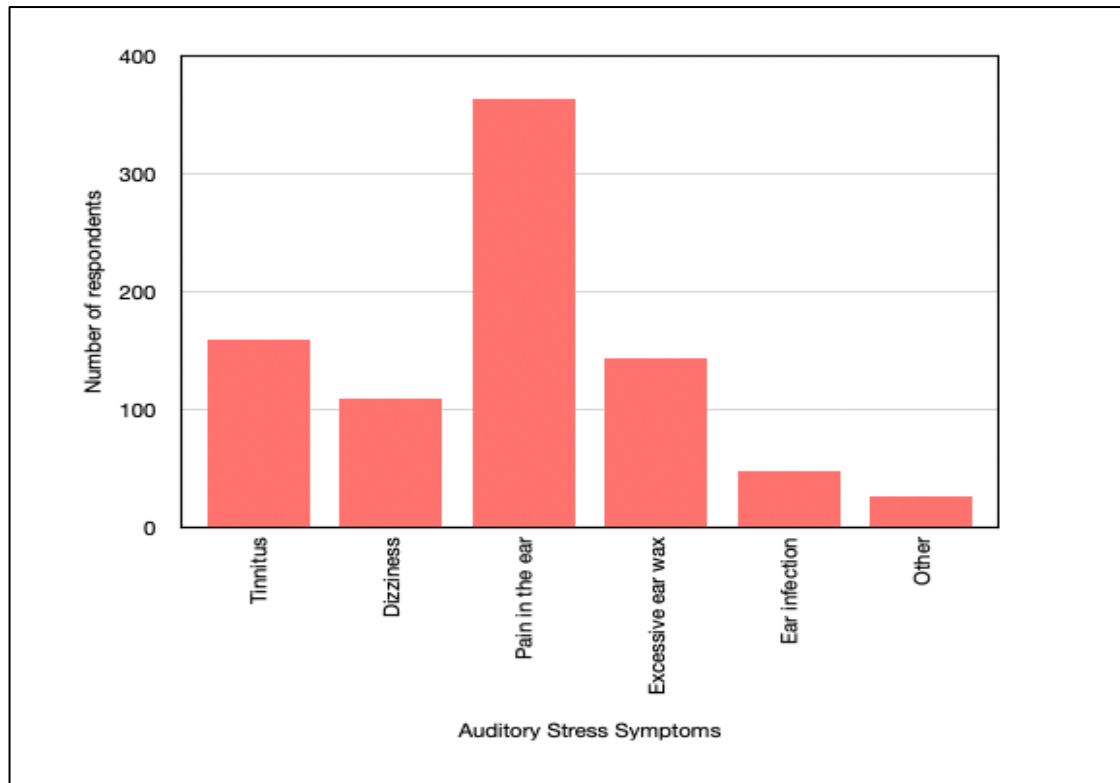


Figure 4: Auditory Stress symptoms

Different De-stressing routines followed

In this section of the questionnaire, the participants were asked to report any de-stressing routines they followed during these pandemic times to keep themselves calm. The participants reported various activities with Listening to music (23.40%), brisk walking (20.54%), exercise (18.20%), reading (15.54%) etc being the most popular stress busters. Many other activities like praying, binge eating, meditation and yoga were also performed. When asked about how effective these activities were, 67.5% of participants stated that these activities helped them to remain calm, resilient and cope with stress.

Discussions:

Neurotropic Properties of SARS-CoV-2

With time several human respiratory viruses, including the coronaviruses have shown the ability to penetrate the Central Nervous System that is Neuroinvasion, with potential neuropathological repercussions. These viruses cause neurovirulence by infecting the neurons and the glial cells of the nervous system.^{4,8} The SARS-CoV-2, like the previously found SARS-CoV, uses the S1 spike protein to aids the attachment of the virion to the host cell by interacting with the

Angiotensin-converting Enzyme-2 (ACE 2) receptor and gaining access to the host cell.⁹ The brain is known to express the ACE2 receptors, which have been traced over the neurons and the glial cells making them a prospective target of the SARS-CoV-2 virus.⁹ The ACE2 expressing neuronal cells are found in the circumventricular organs.⁵ The Blood-Brain Barrier (BBB) and the effective immune response protects the central nervous system organs from most viral infections.⁸ All the circumventricular organs are involved in cardiovascular and respiratory regulation and have little protection of the BBB making these CNS sites prone to many pathologies.⁵

The neurotropic mechanisms of SARS-CoV-2 are yet cryptic, however, the neurotropic mechanisms of the previously found coronaviruses form the base for the determination of the mechanisms of the SARS-CoV-2. Based on this various routes of viral entry into the nervous system have been proposed.

1. Direct spread of the virus from the Cribriform plate to the brain.

SARS-CoV-2 can enter the brain tissues *via* the dissemination and spread from the Cribriform plate of the ethmoid bone, which is close to the olfactory bulb in the brain.^{6,9} The olfactory nerves serve as an easy medium for many viruses to gain entry into the Central nervous system.⁷ The dendrites sent by the olfactory nerves in the nasal cavity extend their axons through the Cribriform plate into the olfactory bulb of the brain.⁷ This supports the presence of Anosmia and hyposmia in the Covid-19 patients.⁶

2. Hematogenous Route.

The BBB serves as a common route for many blood-borne viruses to gain entry into the nervous system and the brain.¹⁰ Due to the internalization and transport of the virus across the endothelium, these viruses can get access to the brain by crossing the BBB.¹⁰ The Covid-19 causing SARS-CoV-2 infects the endothelial cells of the BBB and the leukocytes and spread to other tissues.⁴ The virus enters the cerebral circulation, where the slack movements of the blood into the microvessels, helps the viral spike protein interact with the ACE2 receptors leading to the damage of the endothelium, favouring the entry of the virus into the brain tissues.⁵ The different cytokines associated with SARS-CoV-2 including Interleukin (IL)-6, IL-1 β , tumour necrosis factor, and IL-17 aids in the disruption of the BBB and helps the virus gain entry into the brain.¹⁰

3. Neuronal Route.

The virus can enter the Central nervous system in a retrograde manner *via* active axonal transport by infecting the peripheral nerves.⁴ The motor proteins like Kinesins and dyneins help the virus reach the central nervous system *via* the sensory and motor nerve endings especially of the vagus nerve from the lungs.⁶ Once the virus reaches the brain, it starts to spread from the olfactory bulb to the cortex, medulla, hippocampus, and even the spinal cord, but the cerebellum seems to remain unaffected.⁴

4. Infiltration of infected immune cells.

The autopsy studies of Covid-19 patients have revealed a remarkable lack of immune cell infiltration.¹⁰ The infected immune cells serve as reservoirs for the virus and get carried to the brain. The meninges and the choroid plexus serve as the entry points for these infected immune cells.¹⁰

Neurological Manifestations of SARS-CoV-2

The Covid-19 causing coronavirus can be equated with a spectrum of neurological manifestations which have been studied by autopsies and detailed neurological investigations of the Covid-19 patients.⁹ A study conducted by Mao et al. concluded that 78 out of 214 patients that is 36.4% of patients logged in neurological involvement of the SARS-CoV-2 virus.⁴ These neurological manifestations can be classified based on the part of the neuraxis involved, namely Central nervous system manifestations and Peripheral nervous system manifestations including skeletal muscle injury.⁴

CNS associated manifestations.

1. Headache and Dizziness.

Many studies have reported headache and dizziness as the most common CNS-associated neurologic symptom of Covid-19 causing coronavirus with the prevalence of headache varying from 6.5% to 23%.^{11,4} A study conducted on 138 hospitalized covid-19 patients showed that 13 patients logged in for dizziness, while 9 patients reported headache.¹¹

2. Anosmia and Ageusia

Anosmia refers to the loss of sense of smell while ageusia means loss of taste function of the tongue. Anosmia and ageusia have turned up to be the most common neurological presentation of Covid-19.⁶ These two presentations are one of the leading causes of olfactory dysfunctions in adults.⁴ Up to 40% of cases infected by SARS-CoV-2 reported at least one symptom of olfactory and taste disturbance and 18.3% reported for both.⁴ In 11.8% of the patients, the symptoms of olfactory dysfunction appeared before the other symptoms.⁶ A study revealed that the olfactory and gustatory dysfunctions were common in females, out of the 83% of patients who reported anosmia and ageusia, two-third of them were females.^{4,6} It was remarkable that even without significant nasal inflammation, some cases of Covid-19 presented olfactory disturbances.⁴ It was also reported that the olfactory sensory neurons did not express ACE-2 and Transmembrane protease serine-2, which is required for the SARS-CoV-2 entry, based on which researchers have postulated various mechanisms of viral entry in the olfactory epithelium.⁴

3. Encephalitis and Meningitis

Encephalitis turns out to be a potentially fatal presentation of Covid-19.⁴ The most common causes include viral infections like Herpes Simplex Virus (HSV), Varicella Zoster virus (VZV), Cytomegalovirus (CMV), influenza virus, and other respiratory viruses like SARS-CoV and MERS-CoV.⁶ The symptoms shown may range from mere headache, fever to

altered senses, agitation, coma, etc.⁴ The first case of encephalitis caused by SARS-CoV-2 was reported from Japan by the detection of SARS-CoV-2 RNA in the Cerebrospinal fluid, but the nasopharyngeal swabs of the patient reported negative.^{4,6} Since then many cases have been reported of Encephalitis as a clinical manifestation of Covid-19.

4. Cerebrovascular diseases.

Evidence of cerebrovascular events associated with SARS-CoV-2 has shown up to be one of the neurological manifestations, especially in those who suffer from a severe form of Covid-19.^{4,6} An observational study showed that out of 221 Covid-19 patients, 5% reported acute ischemic stroke, 0.5% cerebral haemorrhage and 0.5% cerebral venous sinus.⁸ More recently a British study revealed that 62% of patients showed cerebrovascular events and 74% developed acute ischemic stroke.⁴ These incidences were more prevalent in older patients having much other chronicity like hypertension, diabetes, cardiovascular risks, and history of stroke.^{4,8} The hypercoagulability related to Covid-19, elevates the risk of cerebrovascular events.¹⁰ The hypercoagulability associated with SARS-CoV-2 infection is called Sepsis Induced Coagulation (SIC) and the depletion of ACE-2 due to the infection results in tissue damage leading to stroke.⁶ Taken together it suggests that SARS-CoV-2 can adversely affect the brain and can also lead to vascular brain injury.

PNS-associated manifestations.

The signs and symptoms of Covid-19 causing SARS-CoV-2 associated with the peripheral nervous system are mild and less severe.¹¹ Skeletal muscle damage (Myopathy), polyradiculopathy and Guillain Barrè Syndrome are some of the PNS manifestations related to SARS-CoV-2. Myalgia, fatigue, weakness are common symptoms of Covid-19 disease with prevalence in 11-70% of patients with Covid-19.⁴ The mechanisms of myopathy development in the Covid-19 patients could be multifaceted:

- 1) Direct viral invasion *via* ACE-2 receptors.
- 2) Damage to muscle cells caused by viral toxins.
- 3) Cytokine-mediated immune response causing muscle damage.⁴

In Italy, five patients have also reported the presence of Guillain Barrè Syndrome Post SARS-CoV- 2 infection.⁶

Neuropsychiatric Impacts of Covid-19

The Covid-19 pandemic has become jeopardy to psychological well-being as prior studies have reported a profound and broad spectrum of emotional and psychological impacts on communities during previous epidemics and pandemics.¹⁴ The current pandemic is found to be associated with anxiety, Chronic depression, emotional instability, distress, sleep disturbances as well as suicidal tendencies.¹⁵ Several studies have been conducted for the general population, school-goers, college students and health care workers. The data collected implied that many individuals had mild to moderate symptoms while severe symptoms were observed in lesser cases.¹³

A lot of factors can be held responsible for such emotional and psychological instability. A study in China has also reported cases of distress and insomnia with the prevalence of 71.5% and 34.0% respectively.¹² India reported a 20% increase in mental health anomalies within a few weeks of lockdown.⁴ Patients with previous comorbidities or Covid-19 infection are at a greater risk of falling into depression and anxiety as compared to the general population.¹⁶ Moreover, health care workers are more prone to succumb to mental health issues due to extra workload, shortage of medical resources, fear of getting infected, separation from families etc.¹³ The prevalence of anxiety and depression among the healthcare workers were found to be 23.2% and 22.8% respectively.¹³ Adolescent populations especially those living in lower economic status families are equally vulnerable.¹⁸ A survey conducted in the UK with 2111 adolescents with prior mental pathologies reported that 83% of the participants agreed that the Covid-19 pandemic has worsened their psychological health scenario.¹⁸ Woefully 91% of the student population has been negatively affected due to nationwide lockdowns and closure of schools, which was more of interactions with mentors and peer groups during pre-lockdown.¹⁹ Children under quarantine are also vulnerable to mental health pathologies.²⁰ The rising pandemic caused anxiety and distress among individuals. The increase of fear and helplessness due to lockdown and isolation have a huge impact on the psychology of students. In a study conducted at the University of Sharjah, UAE out of the total 433 students it was found that 51% exhibited psychological distress.²³ At this point, it is essential to emphasize the importance of psychological health and well-being (physical, economic, social, mental, emotional, psychological, spiritual development and engaging activity, quality of life, life satisfaction and domain-specific satisfaction) of the individuals via proactive psychological mediations during the ongoing pandemic.¹⁴ OCD is one of the most disabling psychiatric disorders with a lifetime prevalence of 1.9–3.3%.¹⁸ Several problems faced by patients with OCD include fear of dirt, feeling of being contaminated and excessive washing & cleaning to name a few.¹⁸ Though the patients with OCD try to resist these thoughts they often fail to do so.¹⁸ According to a survey on medical and non-medical college students, it was evident that fear of negative events and OCD were greatly associated. Excessive fear may give rise to the development of an anxiety disorder.²² It is very crucial to plan policies to improve the overall mental health of individuals during and after the Covid-19 crisis. For this synergetic work by mental health professionals, NGOs and volunteers are required.²¹ As a known fact, the impact of any disaster is long-lasting. The global mental health issues that are emerging in response to the COVID-19 pandemic may evolve into long-lasting health conditions permeated through feelings of vulnerability, isolation/quarantine, fear, anxiety, psychological distress, psychosocial stressors, posttraumatic symptoms, stigma and xenophobia.¹⁴

Conclusion:

In conclusion, this contemporary study provides an espy of the agonising phase of the Covid-19 pandemic on the overall psychological well-being of the adult community living in Mumbai. A wide range of factors can be held responsible for such an emotional and psychological tumult being faced by the majority of the population globally. These mental health issues entering the Covid-19 scenario may evolve into long-standing health concerns perfused through feelings of

fear, anxiety, stigma, stress, vulnerability etc. The results obtained are concerning, suggesting highly escalated rates of anxiety, stress and depression and based on previous studies related to epidemics and pandemics, it can be presumed that mental pathologies are unwelcome aftermath. Overall, individuals going through any kind of psychiatric/emotional stress must be addressed properly.

Based on the results of this study, we recommend researchers that it would be helpful to screen for psychological distress among the population. A similar study on a larger sample would be valuable to allow collation with the results of this study.

At present, there are only a few studies that highlight the neuropsychiatric and socio-psychological phase of the Covid-19 pandemic. This was a purposive study to draw attention to the neuropsychiatric aspects of Covid-19. Jim. E. Willis correctly pointed out that “Sometimes it takes a natural disaster to reveal a social disaster.

Limitations:

This study was based on a self-assessment questionnaire, so there is a possibility of biased results. The participants who indicated or expressed anxiety, psychological distress, or strain on the eye were not clinically examined to affirm their diagnosis.

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Conflict of interest:

The authors declare that they do not have a conflict of interest.

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