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Original Research Article

Prevalence of Neurological Complications amongst Post - COVID-19 Patients Using the Edinburgh Questionnaire: A Cross-Sectional Study in Chhatrapati Sambhajinagar, Maharashtra

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ABSTRACT

Background: The COVID-19 pandemic has led to significant long-term effects beyond respiratory illness, notably involving the nervous system. Increasing evidence indicates that post-COVID-19 syndrome can present with a range of neurological complications. This study aimed to assess the prevalence and awareness of neurological complications among post-COVID-19 patients using the Edinburgh Neuro-symptoms Questionnaire.

Aim: To observe the prevalence of Neurological Complications among Post-COVID 19 patients using Edinburgh Questionnaire.

Methodology: A cross-sectional observational study was conducted among 385 participants from Chhatrapati Sambhajinagar, Maharashtra, all of whom had a history of COVID-19 infection following the inclusion and exclusion criteria. Consent was secured before the assessment. We evaluate the presence and severity of neurological complications in post COVID-19 patients by an Edinburgh Questionnaire. Data was analysed using Microsoft Excel.

Study design: An observational study.

Result: The average age of participants was 46.28 ± 16.87 years; 54.80% were male and 45.20% female. Study revealed that the most common neurological symptoms reported among total participants were fatigue (73.5%), muscle weakness (66.2%), and chronic pain (64.1%). In addition, participants exhibited memory impairments (19.48%), blackouts (20.26%), sensory disturbances (19.4%), as well as postural tremors (6.75) were also identified as the least prevalence complication. Gender analysis revealed a higher prevalence of symptoms among males (54.8%) compared to females (45.2%).

Conclusion: Neurological complications are highly prevalent among post-COVID-19 patients, with fatigue, weakness, and chronic pain being the most common manifestations. Early recognition and targeted neurorehabilitation strategies are critical for improving quality of life in post-COVID-19 patients. Greater awareness among healthcare providers and patients is necessary to ensure timely diagnosis and intervention.

Key Words: COVID-19, Neurological Complications, Post-COVID Syndrome, Edinburgh Questionnaire, Neurorehabilitation, Fatigue, Blackouts, Memory Impairment

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INTRODUCTION

The ongoing COVID-19 pandemic, caused by the recently identified severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), has

taken the world off guard, with mil lions of people worldwide currently dealing with its severe consequences. Although COVID-19 primarily affects the respiratory system, it is increasingly recognized as a systemic disease [1]. Coronaviruses (CoV) are a large family of viruses causing illness ranging from the common cold to more severe diseases [2].

The year 2019 witnessed the emergence of a new Severe Acute Respiratory Syndrome (SARS) virus causing the incidence of pneumonia in Wuhan. The pneumonia was conspicuous because it was not responding to the standard treatment regimen [3] The COVID-19 pandemic has affected people worldwide and poses a severe health threat on a global scale [4] Coronavirus disease 2019 (COVID –19) is caused by SARS-CoV-2 a newly emerged coronavirus which was first recognized in Wuhan, China in December 2019. COVID-19 was declared a pandemic by WHO (World Health Organization) on 11th March 2020. As of 19th February 2021, about 11.08 crore cases were reported globally with 24, 53,582 deaths.

In India as of 19th February 2021, there were 1.09 million cases with 1, 56,111 deaths in country [5]. COVID-19 belongs to the family of single stranded RNA virus. While observing under the electron microscope it appears like crown shape with 60 to 140 nm diameter. It also contains large widely spread club or petal shape spikes. While studying the genetic sequence of the COVID-19 virus it seems that Beta coronavirus closely linked to SARS (severe acute respiratory syndrome) virus. It is seen that there is a decrease in replication of virus in high temperature but it can resist the cold temperature. It is sensitive to ultraviolet rays. The dynamics of SARS-CoV-2 are currently unknown but it is speculated that it has animal origin [5]. COVID-19 belongs to the family of single stranded RNA virus. While observing under the electron microscope it appears like crown shape with 60 to 140 nm diameter. It also contains large widely spread club or petal shape spikes. While studying the genetic sequence of the COVID-19 virus it seems that Beta coronavirus closely linked to SARS (severe acute respiratory syndrome) virus. It is seen that there is a decrease in replication of virus in high temperature but it can resist the cold temperature. It is sensitive to ultraviolet rays.

The dynamics of SARS-CoV-2 are currently unknown but it is speculated that it has animal origin [5]. SARS-CoV-2 receptors also expressed in Glial cells and neurons which could explain the frequently reported manifestations such as Olfactory Neuropathy (Anosmia), Peripheral neuropathy and brain disorders such as Cerebrovascular accidents, Seizures, Meningoencephalitis and other Immune mediated neurological disorders [6]. Two major anatomical infection routes are discovered through which SARS-CoV-2 can enter the CNS, a neural pathway through the PNS and a fluid body pathway through blood, lymph and CSF.

· Peripheral nerve route: contagion via droplets is almost the main transmission route of SARS-CoV-2.

· Hematogenous route: the viruses disturb the endothelial cells in the blood brain barrier or the blood cerebrospinal fluid barrier and then find their way towards the CNS.

· Lymphatic Drainage of the cerebrospinal fluid route: conditions such as viral infections can destroy the lymphatic drainage system of the brain edema and alterations.

Transcribial route: Infection of the olfactory epithelium and successional transmission through the cribriform plate [5,7]. The coronavirus disease 2019 (COVID-19), caused by the novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has had profound implications not only for respiratory health but also for systemic and neurological function. While initially considered a respiratory illness, mounting evidence suggests that SARS-CoV-2 possesses neurotropic and neuroinvasive properties, leading to a spectrum of neurological symptoms that persist well beyond the acute phase of infection—a phenomenon now referred to as **Post-COVID Syndrome (PCS) or Long COVID** Moreover, encephalopathy and cerebrospinal fluid (CSF) abnormalities, including increased inflammatory markers, were also observed in COVID-19 patients suggesting that elevation of CSF cytokines and chemokines following

SARS-CoV-2 infection contributes to neuroin flammation[8]. A range of post-infection neurological complications have been documented in COVID-19 survivors, including tremors[9], muscle weakness [10] memory problems [11], and neuropathic pain[12], often related to nerve damage or immune-mediated responses. It also highlight cognitive issues, including attention deficits and blackouts, which contribute to the broader syndrome of "brain fog "[13]. These neurological symptoms can significantly affect daily functioning and overall quality of life. The underlying mechanisms behind these symptoms may include widespread inflammation, disruption of the blood-brain barrier, and brain injury caused by low oxygen levels [8]. Lack of awareness about neurological complications in Post covid patients may lead to delay in the recognition of problem. This study is an attempt to identify the current awareness among post covid patients. The intention of this study is to describe the key aspects of Neurological Complications due to COVID- 19 with post COVID-19 syndrome focused on the nervous system and the elements that must be taken into consideration during evaluation and Neuro-rehabilitation for patients with neurological complications.

MATERIALS AND METHODS

In this observational study, we recruited 385 individuals who were previously diagnosed with COVID-19. The study was conducted in Chhatrapati Sambhajinagar (Aurangabad) Maharashtra. The data were collected from multiple hospitals to ensure a diverse and representative sample for the study. We included willing participants 18 years and above with a confirmed diagnosis of COVID-19. Written informed consent was obtained from all the participants in there regional language. Edinburgh questionnaire was administered to assess the prevalence of Post COVID-19 Neurological complications. The Edinburgh Neurosymptoms Questionnaire (ENSQ) is a simple and reliable tool used to identify neurological symptoms that may not have a clear physical cause. The questionnaire includes 14 yes-or-no questions, each focusing on different symptoms such as fainting, seizures, weakness in limbs, unusual body movements, speech problems, vision or hearing difficulties, numbness, memory issues, tiredness, pain, trouble walking, swallowing problems, and sleep disturbances. It is a self-reported tool, meaning that patients answer the questions based on their own experiences. The ENSQ has been shown to be highly valid (0.97) and reliable [14], meaning it accurately measures what it is supposed to and gives consistent results over time.

RESULTS

In this study, we evaluate 385 participants using An Edinburgh Questionnaire. The mean age of the participants was 46.28±16.87 years, while the male: female ratio among participants was 5.5:4.5, this mentioned data can be seen in the Table. no.1.

Table 1: Represents General Characteristics of the Participants.

Age (In Years)	46.28 ± 16.87
Gender (Male :Female)	5.5 : 4.5

Table 2: Represents Mean and Standard Deviation of Fatigue and its Component of Edinburgh Neurological Symptom Questionnaire

Sr.no	Edinburgh questionnaire	Mean± standard deviation
1	Have you been lacking energy everyday or almost everyday for the last six months?	0.735064935± 0.441298625±
	A. Does activity makes your fatigue worse?	0.563636364± 0.49593388±

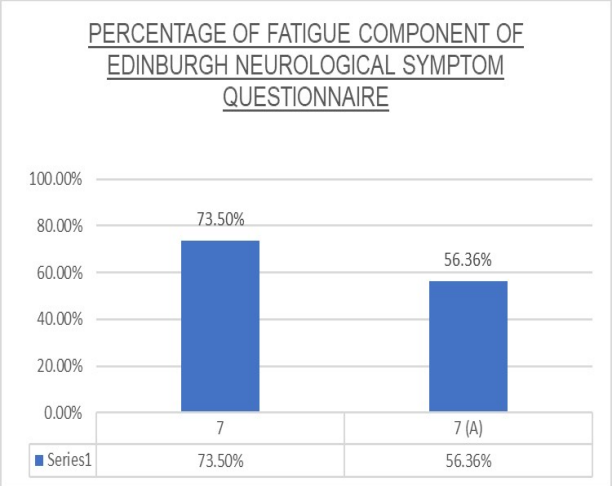

Chart 1: Represents Percentage of Fatigue Component of Edinburgh Neurological Symptom Questionnaire

Table 3: Represents Mean and Standard Deviation of Muscle Weakness and Its Components of Edinburgh Neurological Symptom Questionnaire

Sr.no	Edinburgh questionnaire	Mean ± Standard deviation
	During the last six months have you been bothered by weakness in one or more limb e.g (arms or legs).	0.662337662 ± 0.472912765 ±
	A. Do you drop things frequently?	0.436363636 ± 0.49593388 ±
	B. Does your limb weaknessget worse or better at different times of day?	0.319480519 ± 0.466275366 ±
	C. Does concentrating on trying to move make the limb weakness worse?	0.090909091 ± 0.287479787 ±
	D. At the start of your limb weakness did you feel your heart pounding or did you feel frightened, anxious or very uneasy?	0.098701299 ± 0.298260544 ±
	E. Does your weak limb feel like it does not fully belong to you?	0.093506494 ± 0.299929716 ±

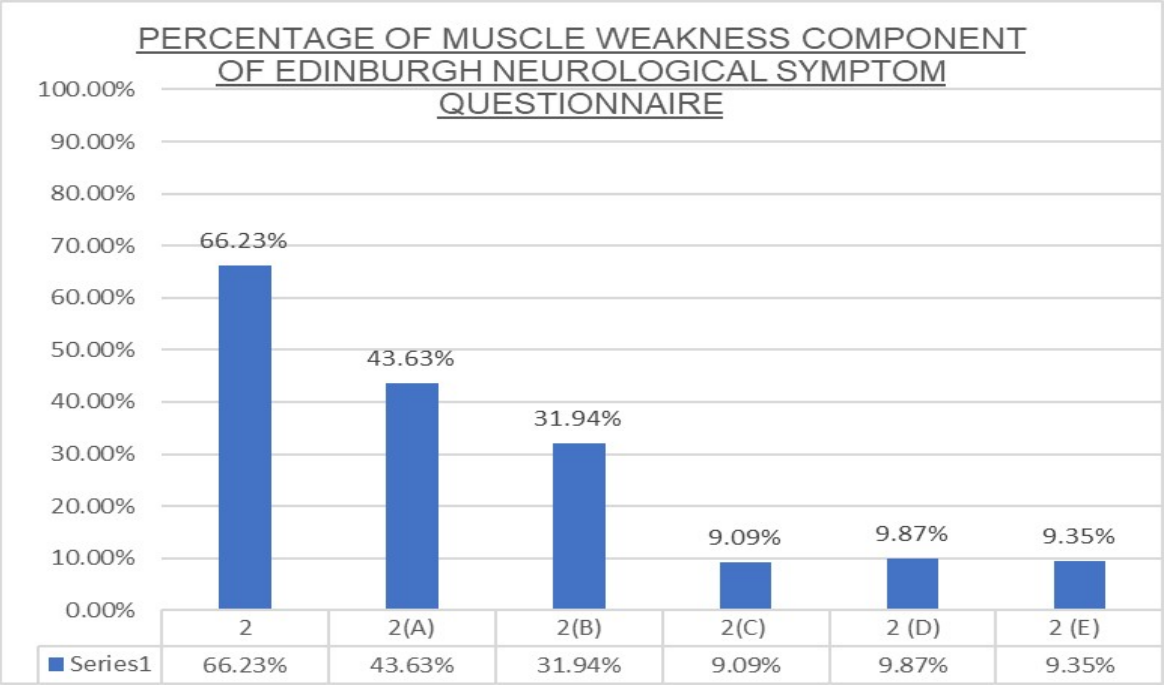

Chart 2: Represents Percentage of Muscle Weakness Component of Edinburgh Neurological Symptom Questionnaire.

Table 4: Represents Mean and Standard Deviation of Pain and its Component of Edinburgh Neurological Symptom Questionnaire

Sr.No	Edinburgh Questionnaire	Mean± Standard Deviation
3	During the last 3 months have you had pain almost every day in more than one part of your body?	0.641558442 ± 0.479542707 ±
	A. Is your pain worst in different parts of your body on different days?	0.498701299 ± 0.499998313 ±

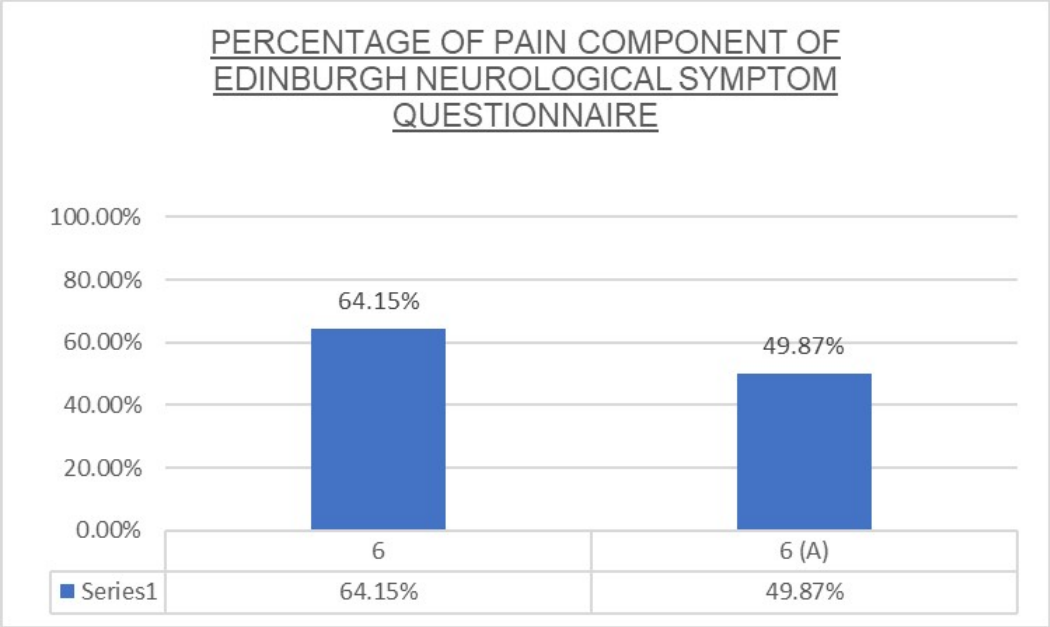

Chart 3: Represents percentage of Pain Component of Edinburgh Neurological Symptom Questionnaire

We observed that fatigue, pain and muscle weakness were the most prevalent manifestations within our population, while memory, blackout, sensory disturbances and tremors were the least common. Also fatigue, muscle weakness and pain exhibited the highest percentage mentioned in chart no. 1, 2 and 3 respectively. Mean and standard deviation of domains of fatigue, muscle weakness, and pain factor are presented in Table no. 2, 3 and 4.

DISCUSSION

This study aimed to explore the neurological complications experienced by individuals recovering from COVID-19 in Chhatrapati Sambhajinagar, Maharashtra, using the Edinburgh Questionnaire. Data from 385 participants revealed a broad range of persistent neurological symptoms, which align with findings reported in global studies of post-COVID conditions. In our study, 54.8% were males and 45.2% were females indicating a potential gender-related susceptibility to these complications. 54.8% were males and 45.2% were females, indicating a potential gender-related susceptibility to these complications.

Among the most frequently reported symptoms were fatigue (42.9%), gustatory dysfunction (35.4%), anorexia (28.9%), olfactory dysfunction (25.3%), headache (10.1%), dizziness (6.7%), and nausea (5.9%). Additionally, cerebrovascular disease emerged as the most common comorbidity (4.3%), which worsened COVID-19 outcomes. Severe neurological complications, such as Guillain-Barre syndrome, encephalitis, meningitis, and stroke, were also noted [15].

A significant number of participants (20.26%) reported blackouts, a symptom linked to brain fog and neurological dysfunction, as demonstrated by Hassan et al. (2023) This suggests that COVID-19's effects extend beyond the respiratory system to impact cognitive and neurological functions [13].

The underlying mechanisms may include disruption of the blood-brain barrier (BBB) due to elevated levels of pro-inflammatory cytokines like IL-1β and IL-6, leading to glial cell activation and neuronal damage.[16] Cytokine storms can exacerbate neuroinflammation, impair synaptic transmission, and alter cerebral blood flow, increasing the risk of blackouts[17]. This viral infection can induce cellular damage through a strong, robust innate immune response via inflammatory cytokine storm and establishing a pro- coagulant state that may contribute to these sequelae and residual symptoms later.[18] Autonomic dysfunction, such as orthostatic hypotension, may further contribute by causing blood pressure fluctuations that lead to transient loss of consciousness [19].

Limb weakness was reported by 66.2% of participants, in line with findings by Payne

et al. (2024) [10], who noted that up to 60% of long COVID patients experience muscle weakness. This condition significantly interferes with daily activities, often worsening after physical exertion. The underlying causes include mitochondrial dysfunction, motor neuron damage, and spinal cord involvement, all contributing to persistent fatigue and muscle weakness. Autoimmune neuromuscular disorders, such as Guillain-Barre syndrome, and secondary complications like ICU-acquired weakness, further complicate recovery. These factors demonstrate the complex and prolonged recovery process for post-COVID patients.

Memory impairment was reported by 19.48% of participants, a finding consistent with research by Ahmed et al. (2022), who documented persistent memory issues in COVID-19 survivors. Cognitive dysfunction, particularly memory deficits, may arise from neuroinflammation, cerebral hypoxia, and mitochondrial dysfunction, all of which impair neuronal function and contribute to memory loss. Factors such as the severity of the acute infection and pre-existing comorbidities appear to influence the extent of cognitive impairment [11].

In our study 6.75% of participants reported experiencing postural tremors or internal vibrations, which are common in patients with Long COVID. Likewise, M. Mahdy's case report highlights postural tremor as a possible neurological complication after COVID-19. The patient developed tremors during arm extension with no prior neurological issues, suggesting a potential link between COVID-19 and new-onset movement disorders. This supports the need for neurological monitoring in post-COVID patients and further research into the virus's effects on the nervous system [9]. These symptoms may be linked to dysautonomia or small fiber neuropathy, as COVID-19 has been shown to affect the autonomic nervous system and peripheral nerves. Longitudinal observations have shown partial improvement in tremor amplitude over time, though symptoms may persist, indicating lasting alterations in neural circuits, particularly in the cerebellum and associated pathways [20].

Chronic pain was reported by 64.15% of participants. The cross-sectional study by Calvache-Mateo et al. found that non-hospitalized post-COVID patients experienced significantly higher levels of chronic pain, central sensitization, insomnia, and psychological distress (e.g., anxiety, depression) even two years after infection. Compared to controls, these patients also reported more fear of movement and greater use of pain medication. The authors suggest that chronic pain in post-COVID syndrome is influenced by both physical and psychological factors, highlighting the need for holistic, multidisciplinary care in long-term COVID-19 recovery [12]. Chronic pain likely results from persistent inflammation, immune dysregulation, and viral neurotropism, as SARS-CoV-2 can directly invade the nervous system, triggering inflammatory responses that compromise the BBB and lead to neuronal damage [21].

Fatigue emerged as the most commonly reported symptom in our study, affecting 73.50% of participants. This finding is consistent with the meta-analysis by Felicia Ceban et al. (2021), which found that 32% of COVID-19 patients continued to experience fatigue at least 12 weeks post-infection [22].

The mechanisms behind post-COVID fatigue likely involve neuroinflammation, BBB dysfunction, and reduced cerebral oxygen delivery due to COVID-19-related hypoxia [23].

Fatigue significantly impacts the quality of life, affecting both physical and cognitive functioning.

CONCLUSION

This study confirms that post-COVID neurological complications are highly prevalent and diverse, significantly impacting survivors' quality of life. It reveals that neurological symptoms such as fatigue, limb weakness, and chronic pain are highly prevalent among post-COVID-19 patients. Our findings align with international literature and underscore the urgent need for integrative long-term care models for COVID-19 survivors. Early screening, patient education, and multidisciplinary

rehabilitation strategies are essential for managing these persistent symptoms. Future studies should incorporate neuroimaging, biomarkers, and longitudinal follow-up to better elucidate underlying mechanisms and treatment approaches.

Conflicts of interest: None

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