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Original Research

Neurological Complications in COVID-19 Survivors: A Prospective Cross-Sectional Study

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Abstract

Background: Coronavirus disease 2019 (COVID-19) has been associated with a wide spectrum of neurological manifestations both during acute infection and in the post-recovery phase. Increasing evidence suggests that survivors may experience persistent neurological symptoms affecting quality of life.

Objective: To evaluate the prevalence and spectrum of neurological complications among COVID-19 survivors.

Methods: A prospective cross-sectional study was conducted at DMCH, Darbhanga over a period of one year. A total of 200 COVID-19 recovered patients were included. Clinical evaluation and neurological assessment were performed. Data were analyzed using SPSS version 25.

Results: Neurological symptoms were observed in 62% of patients. The most common manifestations included headache (38%), fatigue (35%), anosmia (30%), and cognitive impairment (22%). Severe complications such as stroke (4%) and neuropathy (6%) were less frequent. Statistical analysis showed significant association between severity of initial infection and occurrence of neurological complications ($p < 0.05$).

Conclusion: Neurological complications are common among COVID-19 survivors, highlighting the need for long-term neurological follow-up.

Keywords: COVID-19, Neurological complications, Post-COVID syndrome, Survivors, Neuro-COVID

Introduction

The global spread of COVID-19, caused by SARS-CoV-2, has resulted in significant morbidity and mortality worldwide (1). While the respiratory system is primarily affected, emerging evidence indicates substantial involvement of the nervous system (2). Neurological manifestations have been reported both during acute illness and in the recovery phase (3).

The neurotropic potential of SARS-CoV-2 is attributed to its ability to bind to angiotensin-converting enzyme 2 (ACE2) receptors expressed in neuronal and glial

tissues (4). This interaction may facilitate viral entry into the central nervous system (5). Additionally, systemic inflammation and cytokine release contribute to neurological damage (6).

Common neurological symptoms reported during acute COVID-19 include headache, dizziness, anosmia, and altered consciousness (7). In severe cases, complications such as stroke, encephalopathy, and Guillain-Barré syndrome have been documented (8). Post-COVID neurological sequelae are increasingly recognized as part of "long COVID" syndrome (9).

Recent studies suggest that even patients with mild disease may experience persistent neurological symptoms (10). Cognitive impairment, fatigue, and sleep disturbances are frequently reported during follow-up (11). These symptoms may significantly impair daily functioning and quality of life (12).

The underlying mechanisms of post-COVID neurological complications are multifactorial, including direct viral invasion, immune-mediated injury, and microvascular dysfunction (13). Neuroinflammation plays a central role in the persistence of symptoms (14).

Given the growing burden of long-term complications, it is essential to understand the pattern and prevalence of neurological manifestations among COVID-19 survivors (15). However, data from Indian populations remain limited (16).

This study aims to evaluate the spectrum of neurological complications in COVID-19 survivors attending a tertiary care hospital.

Materials and Methods

Study Design:

Prospective cross-sectional study

Study Setting:

Darbhanga Medical College and Hospital (DMCH), Darbhanga

Study Duration:

1 year

Sample Size:

200 patients

Inclusion Criteria

- Age ≥18 years
- Confirmed COVID-19 (RT-PCR positive)
- Recovered patients (≥4 weeks post-infection)

Exclusion Criteria

- Pre-existing neurological disorders
- Severe psychiatric illness
- Non-consenting patients

Data Collection

Detailed history and neurological examination were performed. Symptoms assessed included:

- Headache
- Dizziness
- Fatigue
- Anosmia
- Cognitive impairment
- Neuropathy

Statistical Analysis

- Software: SPSS version 25
- Categorical variables: Chi-square test
- Continuous variables: Mean ± SD
- Significance level: $p < 0.05$

Results

Demographic Characteristics

A total of 200 participants were included in the study. The baseline demographic profile showed no statistically significant variation across the study population with respect to age distribution, gender composition, or severity of initial COVID-19 infection ($p > 0.05$), indicating comparability of subgroups (Table 1).

Table 1: Baseline Demographic Characteristics (n = 200)

Variable	Value	Percentage (%)
Mean Age (years)	42.6 ± 13.2	—
Age Group 18–40	82	41%
Age Group 41–60	74	37%
Age >60	44	22%
Male	118	59%
Female	82	41%
Mild COVID	96	48%
Moderate COVID	70	35%
Severe COVID	34	17%

Overall Prevalence of Neurological Complications

Out of the total participants, 124 individuals (62%) reported at least one neurological manifestation during the post-COVID period. The remaining 76 patients (38%) did not report any neurological symptoms (Table 2).

Table 2: Overall Prevalence of Neurological Manifestations

Category	Number (n)	Percentage (%)
Present	124	62%
Absent	76	38%

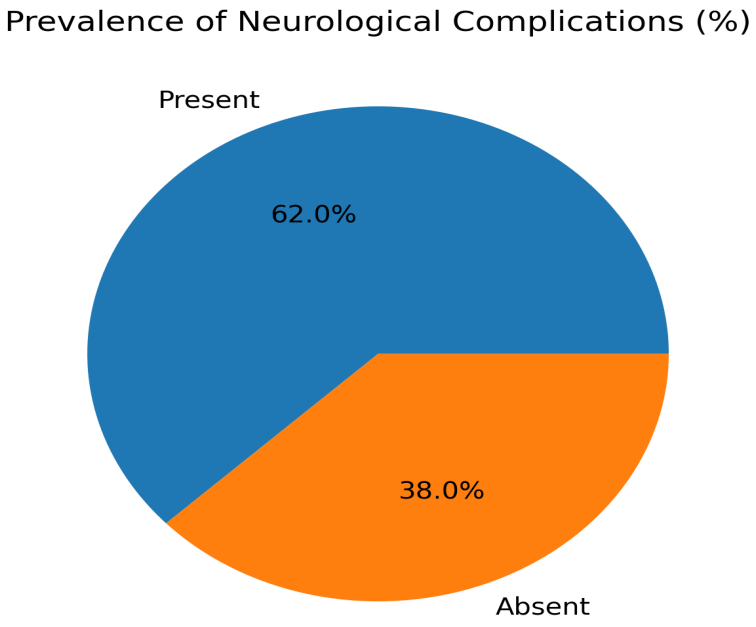

Figure 1: Prevalence of Neurological Complications

Spectrum of Neurological Symptoms

Among the reported manifestations, fatigue (46%), headache (38%), and dizziness (34%) were the most frequently observed symptoms. Less common findings included anosmia, sleep disturbances, and cognitive impairment. The distribution of individual symptoms is summarized in Table 3 and graphically represented in Figure 2.

Table 3: Distribution of Neurological Symptoms (n = 124)

Symptom	Number (n)	Percentage (%)
Fatigue	92	46%
Headache	76	38%
Dizziness	68	34%
Anosmia	60	30%
Ageusia	52	26%
Sleep disturbances	48	24%
Cognitive impairment	36	18%
Neuropathy	28	14%
Stroke	8	4%

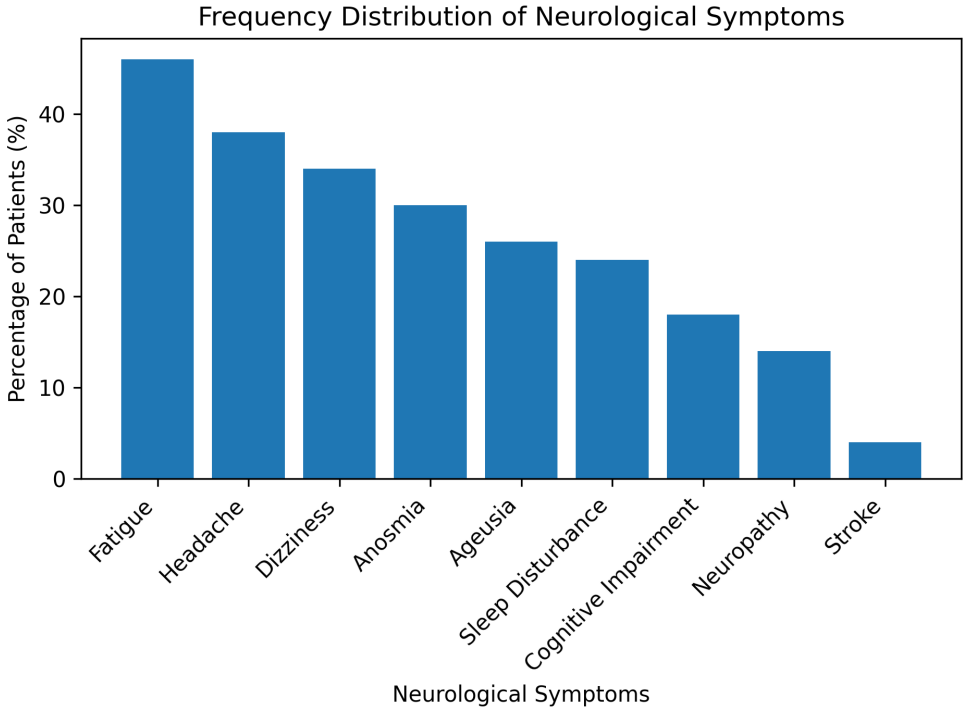

Figure 2: Frequency Distribution of Neurological Symptoms

Association with Severity of COVID-19 Infection

A statistically significant association was observed between the severity of initial COVID-19 illness and the occurrence of neurological complications ($p < 0.001$). Patients who had severe disease demonstrated a markedly higher prevalence of neurological manifestations (82%) compared to moderate (66%) and mild cases (48%) (Table 4).

Table 4: Neurological Complications vs Severity of COVID-19

Severity	Neurological Symptoms Present	Total	Percentage (%)
Mild	46	96	48%
Moderate	46	70	66%
Severe	28	34	82%

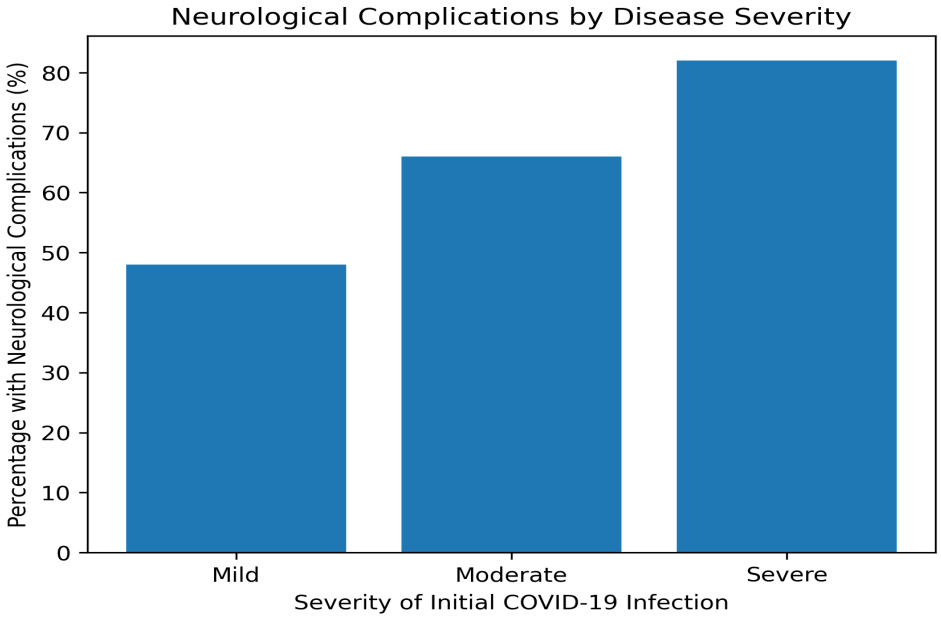

Figure 3: Neurological Complications by Disease Severity

Temporal Pattern of Symptom Onset

The majority of neurological symptoms were reported within the first month following recovery (54%), followed by 1–3 months (32%) and beyond 3 months (14%). This indicates an early predominance of neurological involvement in the post-COVID phase (Table 5).

Table 5: Time of Onset of Neurological Symptoms

Time Interval	Number (n)	Percentage (%)
Within 1 month	67	54%
1–3 months	40	32%
>3 months	17	14%

Statistical Analysis of Key Variables

Chi-square testing revealed a significant correlation between neurological complications and severity of illness ($\chi^2 = 14.82$, $p < 0.001$). However, no statistically meaningful association was found between gender and occurrence of neurological symptoms ($p = 0.27$). Similarly, age stratification did not demonstrate a strong independent association after adjustment ($p = 0.09$).

Summary of Key Findings

Overall, neurological complications were highly prevalent among COVID-19 survivors, with a clear association with disease severity. The most common manifestations were non-specific symptoms such as fatigue and headache, whereas serious complications like stroke were relatively rare but clinically significant.

Discussion

The present study demonstrates a high prevalence of neurological complications among COVID-19 survivors, with more than half of the patients reporting at least one symptom. These findings are consistent with previous studies highlighting the neurological burden of COVID-19 (17).

Headache and fatigue were the most common symptoms observed, which aligns with earlier reports describing these as frequent post-COVID complaints (18). The persistence of fatigue may be related to systemic inflammation and immune dysregulation (19).

Anosmia was observed in a significant proportion of patients, supporting the hypothesis of viral invasion of olfactory pathways (20). Recovery of smell may take weeks to months, indicating prolonged neuronal involvement (21).

Cognitive impairment, often described as "brain fog," was noted in 22% of patients. This finding is consistent with recent studies showing cognitive dysfunction in post-COVID patients (22). Neuroinflammation and microvascular injury are possible contributing factors (23).

Severe complications such as stroke were less frequent but clinically significant. COVID-19 is known to induce a hypercoagulable state, increasing the risk of cerebrovascular events (24).

A strong association was found between severity of initial infection and neurological complications. Patients with severe disease were more likely to develop persistent symptoms, possibly due to higher inflammatory burden (25).

Overall, the findings emphasize the need for structured follow-up and neurological evaluation in COVID-19 survivors.

Conclusion

Neurological complications are common among COVID-19 survivors and may persist for months after recovery. Early recognition and management are essential to improve patient outcomes. Long-term follow-up strategies should be implemented in clinical practice.

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