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ISNI: 0000 0004 8495 2390

Dolna 17, Warsaw,
Poland 00-773
+48 226 0 227 03
editorial_office@rsglobal.pl

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POST-COVID-19 COGNITIVE IMPAIRMENT AS A NEUROPSYCHIATRIC SYNDROME: A REVIEW OF MECHANISMS, CLINICAL FEATURES, AND IMPACT ON QUALITY OF LIFE

Natalia Żelichowska *(Corresponding Author, Email: natalia.zelichowskaa@gmail.com)*
Medical University of Warsaw, Warsaw, Poland
ORCID ID: 0009-0004-2258-1464

Aleksandra Grotkowska
Medical University of Warsaw, Warsaw, Poland
ORCID ID: 0009-0001-4952-9074

ABSTRACT

Introduction: Post-COVID-19 Condition (PCC), commonly referred to as long COVID, has become a major post-pandemic health issue, with many individuals experiencing persistent cognitive and neuropsychiatric symptoms. These difficulties, often described as "brain fog", include problems with memory, executive functioning and processing speed, and can markedly disrupt daily life, emotional well-being and work capacity.
Methods: A narrative review was performed using PubMed and Google Scholar. Keywords included "post-COVID cognitive impairment", "long COVID", "neurocognitive dysfunction", and related terms. Original studies, cohort research, systematic reviews and meta-analyses were screened for relevance. Documents from WHO, NICE were also reviewed to supplement diagnostic definitions.
Results: Current studies consistently indicate that cognitive impairment represents one of the most common manifestations of long COVID, with estimates ranging from 20% to 30%. Difficulties with executive function, memory, sustained attention and information-processing speed form the core pattern of impairment and exert a meaningful impact on daily independence and well-being. Neuroimaging findings support these complaints, showing corresponding metabolic, structural and microvascular changes. Proposed mechanisms most often involve sustained neuroinflammation, immune imbalance, endothelial injury and microvascular dysfunction.
Conclusions: Post-COVID cognitive impairment remains a significant clinical challenge, affecting daily functioning and long-term recovery for many patients. Clearer diagnostic criteria and improved assessment tools integrating neuropsychological testing, imaging and biomarker data are needed to enhance recognition and to identify those at higher risk. Ongoing research into therapeutic strategies remains essential for optimising long-term management and outcomes in affected patients.

KEYWORDS

Long COVID, Cognitive Impairment, Brain Fog, Neuropsychiatric Symptoms, Post-Acute Sequelae of SARS-CoV-2, Quality of Life

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1. Introduction

Coronavirus disease 2019 (COVID-19), infection caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), is a multisystem condition that may be associated with complications at initial presentation or as they evolve during the acute phase of illness [1]. Beyond the acute phase, many patients face numerous prolonged health challenges. Post COVID Condition (PCC), commonly known as "long COVID", occurs in those with a history of SARS-CoV-2 infection. It is characterized by symptoms emerging three months post-onset, lasting at least two months, and lacking an alternative explanation [2]. Long COVID often limits a person's ability to live independently, disrupting work, home life, and social relationships. Because the neurological and psychiatric aspects are particularly disabling, this article reviews the latest research on how the condition affects mental health and cognition.

2. Methodology

A literature search was conducted using the PubMed and Google Scholar databases to identify publications addressing cognitive, neurological and neuropsychiatric consequences of COVID-19. The search covered articles published between January 2020 and September 2025 and was limited to studies available in full text and published in English. Search terms included combinations of: "post-COVID cognitive impairment", "long COVID", "neurocognitive dysfunction", "neurological sequelae", "cognitive symptoms", "SARS-CoV-2".

The review incorporated original research articles, cohort studies, systematic reviews, meta-analyses relevant to post-COVID cognitive dysfunction. In addition, documents from major public health institutions (WHO, NICE) were included due to their role in defining diagnostic criteria and clinical characterisation of the condition.

Studies were considered if they described cognitive symptoms, reported objective cognitive outcomes, presented neuroimaging findings, outlined symptom trajectories or examined proposed biological mechanisms. Publications not addressing cognitive aspects of post-COVID illness, lacking accessible full text, or involving paediatric populations were excluded.

The gathered evidence was synthesised narratively, as the included sources varied substantially in methodology, populations studied and outcome measures.

3. Definitions and Epidemiology

3.1 Definitions and Classification

Since the beginning of the pandemic, the terminology and clinical definitions characterizing the post-acute phase of COVID-19 have undergone substantial changes. The condition is now widely accepted as a multisystemic health condition affecting individuals for an extended period of time following recovery from the acute phase [3].

- **World Health Organization (WHO)**: WHO defines the condition as occurring in individuals with a history of probable or confirmed SARS-CoV-2 infection, usually three months from the onset of COVID-19, with symptoms that last for at least two months and cannot be explained by an alternative diagnosis [2].
- **NICE Guidelines:** The UK health system utilizes the term "post-COVID-19 Syndrome" for signs and symptoms that develop during or after an infection consistent with COVID-19, continue for more than 12 weeks, and are not explained by an alternative diagnosis [4].

Instead of defining long COVID as a single disease, it is now understood as a collection of overlapping health issues, formally called Post-Acute Sequelae of SARS-CoV-2 infection (PASC). To make this definition usable for science, researchers have created scoring systems; for instance, the RECOVER study uses a checklist of 12 symptoms such as brain fog, post-exertional malaise, and dizziness, to determine if a patient meets the threshold for PASC [5,6].

3.2 Epidemiology of Neuropsychiatric Sequelae

Neuropsychiatric symptoms are commonly reported among individuals with long COVID.

In a meta-analysis of 10,530 patients, Premraj et al. reported fatigue (37%), brain fog (32%), memory impairment (28%), and attention difficulties (22%) were the most prevalent neurological complaints. Psychiatric outcomes, such as sleep disturbances (31%), anxiety (23%), and depression (17%), were similarly frequent [7].

Consistent with these findings, an online survey-based study conducted by Kim et al. showed that the most frequently reported complaints among respondents, lasting up to one year after infection, were

concentration difficulties, cognitive impairment and memory deficits [8]. Furthermore, according to a meta-analysis by Ceban et al. cognitive impairment persists in 22% of individuals twelve or more weeks after infection diagnosis [9]. Similarly, a meta-analysis of 47 studies by Elboraay et al. indicated an overall prevalence of cognitive impairment at 27.1%, with findings showing that 27.8% of over 1.2 million patients experienced memory problems [10]. Among 38 individuals assessed with neuropsychological testing, Ferrucci et al. found deficits in processing speed in 42.1% of participants, and delayed verbal recall in 26.3% [11].

In a comprehensive cohort study encompassing over 1.2 million patients, Taquet et al. demonstrated that while the risks of common psychiatric disorders (mood and anxiety disorders) returned to baseline within 1–2 months after viral infection, the risks of cognitive impairment remained elevated at the end of a two-year follow-up period [12]. Although the proportion of individuals reporting at least one long COVID symptom declines over time, data from a separate observational cohort revealed that approximately 10% of 2,231 participants continued to meet criteria for persistent post-COVID symptoms six months after infection [5,13].

3.3 Risk Factors

Various demographic and clinical factors interact to determine the risk of long COVID and its associated neuropsychiatric complications:

- Sex: When considering sex as a risk factor, the data point to distinct clinical outcomes for males versus females. Some data suggests that participants with a higher risk of long-term sequelae were "mostly male" [13]. In contrast, other studies indicate that women face a significantly higher risk than men for symptoms such as fatigue, headaches, depression, and anosmia. A greater prevalence of anxiety, PTSD, dysgeusia, and vertigo was also noted in females, though these findings were not statistically significant [14].
- Age: The risk profile varies distinctly across age groups among the adult population. Compared to younger individuals, older adults exhibit a higher susceptibility to first-time neurological and neuropsychiatric diagnoses [12]. Statistical analysis demonstrates that the prevalence of fatigue, cognitive dysfunction, and amnesia is significantly elevated in the cohort aged 50 years and above relative to younger subjects. Supporting this age-related trend, objective findings indicate that patients aged 55 and above perform worse on verbal memory tasks than those under 55 [11]. On the contrary, younger adults (18–49) appear to more frequently report specific symptoms such as concentration difficulties [8].
- Disease Severity: Evidence supports a clear association between how severe the primary infection was and how long complications persist. Higher rates of PTSD, sleep disruption, cognitive deficits, concentration difficulties, and taste impairment were observed in patients who experienced severe acute infection[13]. Patients who experienced acute respiratory distress syndrome (ARDS) show significantly poorer verbal memory outcomes [11]. Individuals treated in the intensive care unit demonstrate more extensive post-COVID microvascular dysfunction in the brain relative to non-ICU hospitalized patients [15].
- Comorbidities: Research shows that lifestyle and pre-existing conditions play a major role in patients' long-term outcomes. Obesity, for instance, is a recognized risk factor for developing cognitive deficits after recovery. Individuals with obesity face a higher risk of executive function and processing speed deficits, particularly when accompanied by low cognitive reserve, depression, and employment instability [16].
- Socioeconomic Factors: While data show higher rates of respiratory and neurological complaints in high-income countries, this could be attributed to differences in how cases are diagnosed or the fact that more patients survive the acute phase in these regions [13]. Conversely, changes in employment status and lower cognitive reserve were predictors of poorer performance on mental processing tasks [16].
- Viral Variants: Finally, the infecting variant may alter the risk profile. The risk of neurological and psychiatric diagnoses was found to be greater with the emergence of the delta variant (e.g., for cognitive deficit, epilepsy or seizures, and ischaemic strokes) than just before its emergence [12].

4. Clinical Manifestations of Long-COVID Related Cognitive Dysfunction

4.1 Cognitive Impairment

Neurological sequelae of SARS-CoV-2 infection can create short- and long-term challenges both for patients and clinicians. One of the symptoms reported most often is a form of cognitive disturbance, commonly described as "brain fog". It frequently occurs together with fatigue [17]. Importantly, these subjective complaints reflect genuine cognitive difficulties observed in clinical research. Patients affected by Long-COVID show over twofold higher risk of memory and concentration difficulties compared with individuals without a prior infection [18], which highlights the clinical importance of these disturbances.

Panagea et al. found that several cognitive areas are affected in people with long COVID, most often executive function, memory, attention and processing speed, while language remains an insufficiently explored domain [19]. In addition, Ariza et al. also observed that attention and processing speed emerged as the most prominent areas [16].

Objective findings provide further support for how widespread these cognitive deficits are. As shown by Ferrucci et al., 42.1% of previously hospitalized patients, assessed five months after discharge, demonstrated impaired processing speed on the Symbol Digit Modalities Test (SDMT). Additionally, 26.3% had delayed verbal recall deficits and 10.5% showed immediate recall impairments on the Selective Reminding Test (SRT) [11]. Similarly, Graham et al. reported abnormal neurological findings in 53% of patients, most often involving short-term memory deficits (32%) and attention difficulties (27%) [20]. In parallel with these findings, Zeng et al. found that cognitive and memory impairment were among the most frequently described neurological symptoms in post-COVID cohorts, reaching 19.7% and 17.5% respectively [13].

Current research implies that cognitive difficulties are highly prevalent among PCC patients and may persist. In a longitudinal study, Taquet et al. demonstrate an elevated risk of cognitive impairment for up to two years after COVID-19 infection, while other mood and anxiety disorder risks return to baseline [12]. These observations highlight that post-COVID cognitive impairment is not a transient complaint and it creates clinical challenges that require careful assessment and ongoing study.

4.2 Neuropsychiatric Symptoms

In the months following the initial infection, a substantial number of COVID-19 survivors have been documented to suffer from neuropsychiatric symptoms such as depression and anxiety. Countless individuals have faced a significant amount of new stressors as a result of the pandemic. It is possible that the increased incidence of anxiety, depression, and sleep issues in COVID-19 patients stems from the general population's experience of social isolation and restricted access to mental health services. Additionally, individuals with pre-existing mental health conditions reported a significant worsening of their symptoms. [17,19].

A large-scale meta-analysis by Zeng revealed that while pulmonary abnormalities detected via imaging and function tests were the most prevalent investigation findings, there was a substantial burden of generalized and neuropsychiatric sequelae. Fatigue was a frequently reported generalized symptom, while approximately one in five patients experienced psychiatric or neurological complications. Depression and PTSD were the predominant psychiatric manifestations, whereas cognitive deficits and memory impairment were the most common neurological issues. Regarding anxiety, patients were significantly more likely to report mild to moderate symptoms rather than severe or very severe presentations [13].

Another study performed by Graham reveals similar statistics comparing uninfected individuals to those who have survived COVID-19. It indicates a SARS-CoV-2 infection to be associated with a substantially higher likelihood of experiencing fatigue, breathing difficulties, and cognitive issues like memory and concentration loss compared to uninfected controls. In the cohort of patients who managed the acute phase of the illness in an outpatient setting, fatigue is identified as the primary clinical manifestation. This is often comorbid with significant neuropsychiatric sequelae, including depression and anxiety, in addition to respiratory compromise such as dyspnea. Other frequently noted clinical presentations comprise chest pain, sleep disturbances, autonomic dysfunction (characterized by lability in heart rate or blood pressure), and gastrointestinal symptoms [20].

Clinical evidence frequently highlights the comorbidity of cognitive impairment with psychiatric sequelae, including anxiety, depression, and a heightened sense of vulnerability. Quantitative studies support this connection, demonstrating that patients with more severe depression during recovery also tend to suffer from greater cognitive dysfunction[19,21]. It is worth noting that the length of time a patient shed the virus did not influence their cognitive results. In contrast, higher depression scores on the Beck Depression Inventory-II (BDI-II) were found to notably correlate with lower performance in recalling verbal information after a delay [11].

Research by Taquet demonstrates that psychiatric sequelae follow distinct risk trajectories. The elevated risk for common conditions, such as mood and anxiety disorders, is transient, returning to baseline within 1–2 months (43 days and 58 days, respectively). In contrast, the risk for psychotic disorders, dementia, and seizures remains significantly elevated throughout the entire two-year follow-up period [12]. Additionally, according to a study conducted by Zeng et al., the prevalence of PTSD symptoms demonstrated a significant longitudinal decline, dropping substantially from the initial months post-infection to the 6–12 month follow-up period [13]. Although some sequelae are temporary, others appear to reflect persistent neurobiological alterations.

The subjective toll of these symptoms is significant, with some patients expressing a fundamental loss of self. This experience is often compounded by an overwhelming and constant state of depression that does not fluctuate like typical depressive episodes [21].

4.3 Somatic Associations and other Neurological Manifestations

Alongside cognitive and psychiatric issues, long COVID causes various physical symptoms, with fatigue being the most common and debilitating complaint [10]. Research conducted by Ferrucci, using the Subjective Scale of Damage indicates that half of patients suffer from a moderate to severe rise in fatigability [11]. This symptom is highly variable; patients describe fluctuating intensity and differing paths to recovery [21]. Current research points to a complex pathology driven by the interplay of physiological and psychological elements affecting both the central and peripheral nervous systems [22].

Sleep issues are closely tied to fatigue and often appear alongside attention problems. These disturbances are more than just a symptom; they actively worsen cognitive function in patients recovering from COVID-19 [10,19].

One of the most common characteristics of long COVID is sensory dysfunction. One study found that over half of patients (55.3%) experienced decreased sense of smell or taste during their illness [11]. Further analyses have determined that persistent olfactory and gustatory dysfunctions affect 15.1% and 10.6% of patients, respectively; these sequelae are regarded as highly specific clinical indicators of COVID-19 infection [13]. The extent of sensory impairment varies notably, presenting as either subtle changes in smell or taste or complete loss of these senses [21].

Motor complaints are also present, specifically regarding fine motor skills. Patients have specifically described difficulties in maintaining a grip on items, sometimes dropping them without realizing it [21].

Affecting up to a third of patients, neurological manifestations are a primary complication of long COVID [23]. Headaches are the most frequent non-specific neurological symptom and often continue past four weeks, making them a core component of PCC [17]. Symptoms like dizziness and migraines also contribute significantly to the difficulties patients face [10]. Although the risk of being diagnosed with a new complication eventually drops back to baseline, the overall number of people affected remains high even two years after they were infected [12].

5. Pathophysiological Mechanisms

5.1 Mechanisms Underlying Post-COVID Cognitive Impairment

The underlying mechanisms of long COVID cognitive impairment remain elusive [17]. Nonetheless, emerging evidence points to a synergistic effect of several pathological processes, including direct viral injury, the sequelae of critical illness, sustained inflammatory responses, brain hypoxia, and peripheral organ damage [19]. In addition, ongoing inflammation, autoimmune reactions, endothelial damage, and imbalances in the microbiota are considered central mechanisms underlying these neurological complications [6]. Recent proposals suggest the SARS-CoV-2 nucleoprotein N acts as a central hub connecting the virus to the body's immune, inflammatory, and neurotransmitter systems, which may explain the wide array of observed symptoms [24].

5.2 Neuroinflammatory Mechanisms

Central to the development of cognitive problems is neuroinflammation. Beyond the potential for direct viral cytotoxicity, the activation of the neuroimmune axis, specifically the interaction between neurons and glial cells like astrocytes, microglia, and oligodendrocytes, is a leading theory [17]. Another hypothesis suggests that abnormal immune responses produce CCL11, which activates microglia to inhibit neuron growth and damage myelin, causing cognitive deficits [23]. Neurological issues are further intensified when systemic inflammation breaches the blood-brain barrier, allowing cytokines to cross into the brain where they can cause additional damage [8].

5.3 Immune Dysfunction and Autoimmunity

Immune dysregulation constitutes a central mechanism in the pathogenesis of post-acute sequelae. In severe cases, the 'cytokine storm' creates a hyperinflammatory environment that, when compounded by hypoxia and coagulopathy, is implicated in the development of cognitive decline [19]. Furthermore, neuroinflammation and associated neurotransmitter deficits related to the immune response are hypothesized to underpin the chronicity of psychiatric syndromes [13]. Additionally, there is evidence that autoimmunity plays a role in the condition. Research has shown that half of patients who tested positive for SARS-CoV-2 had elevated antinuclear antibody levels, compared to just under a third of those who tested negative. [20].

5.4 Endothelial and Microvascular Dysfunction

Vascular integrity serves as a critical determinant of cognitive prognosis, as evidenced by the widespread cerebral microvascular dysfunction observed in COVID-19 survivors. Furthermore, elevated lactate levels during intensive care, a marker of acute physiological stress, demonstrate a positive association with the severity of long-term microvascular impairment, thereby underscoring the persistent vascular sequelae attributable to severe acute illness [15].

Researchers have also proposed that inflammation of the brain's blood vessels (endotheliitis) contributes to neurological symptoms [20]. However, this does not appear to be a result of low oxygen; studies found no relationship between processing speed deficits and oxygen saturation levels, suggesting the root cause lies elsewhere [11]. Additionally, blood vessel dysfunction has been found even in parts of the brain that appear healthy on standard images, pointing to widespread, invisible damage [15].

5.5 Direct and Indirect CNS Effects

It is hypothesized that persistent cognitive impairment may originate from direct viral invasion of the central nervous system. Investigators propose that specific cognitive deficits are a consequence of cerebral alterations attributable to viral neurotropism, distinct from those secondary to systemic hypoxemia or other general sequelae [11].

6. Imaging and Biomarker Evidence

Neuroimaging offers insight into how structural and functional brain changes may be linked to cognitive impairment in long COVID. According to FDG-PET results from Guedj et al. indicate that patients with PCC show reduced metabolism in several key regions involved in memory and higher cognitive processes, most notably the temporal lobe (including the hippocampus and amygdala), the thalamus and the cerebellum. These metabolic changes parallel the cognitive problems with memory and concentration patients describe, implying a neural contribution to their symptoms [25].

Structural MRI further illustrates that changes in brain volume can mirror how well patients perform on cognitive tasks. Dadsena et al. showed that long-COVID patients can exhibit asymmetric volume changes in the postcentral gyrus, which were closely tied to executive-function performance. The pattern suggested that when one hemisphere showed reduced volume, the opposite side appeared to compensate functionally, and later even showed signs of volume recovery. This imaging pattern strongly supports the idea that the brain actively tries to compensate for, and gradually repair, the cognitive disruption seen in PCC [26].

Advanced microvascular imaging has also provided important insights into vascular involvement in PCC. Using 3C-IVIM, Van der Knaap et al. demonstrated that patients with long COVID, particularly those who required ICU care, show reduced microvascular perfusion across cortical grey matter and both normal-appearing and abnormal white matter. Notably, the abnormalities were detectable in regions that appeared structurally normal on conventional MRI. Even though the findings did not consistently match objective cognitive tests scores, they closely aligned with patients' subjective complaints. According to Van der Knaap et al., further research is required to assess whether these vascular changes can predict later cognitive decline and if 3C-IVIM could serve as an early biomarker to identify individuals at risk [15].

Conversely, standard laboratory and autoimmune markers do not seem to capture neurological involvement. In the studied cohort, Graham et al. found that routine inflammatory markers (ESR, CRP, D-dimer and ferritin) were similar in patients with persistent symptoms and in the control group. ANA testing also did not help distinguish the two groups, and higher titres often reflected pre-existing autoimmune disease. These data indicate that widely used laboratory markers are too limited to explain cognitive difficulties in long COVID, pointing toward a need for more targeted immune-based biomarkers such as T-cell assays [20].

While imaging provides clearer evidence of brain involvement in PCC, recently examined biomarkers offer limited diagnostic insight. Recent reviews emphasise the need for standardized neuropsychological tests and integrating biomarkers into future research to improve early identification of individuals at risk [19].

7. Impact on Quality of Life

7.1 Daily Functioning

Post-COVID-19 Condition (PCC) profoundly compromises functional independence, disrupting both Activities of Daily Living (ADLs), such as essential self-care, and Instrumental Activities of Daily Living (IADLs), including basic household management. Patient testimonies point out the severity of these limitations; for instance, the physical exertion required for basic hygiene like showering can lead to exhaustion due to dyspnea and fatigue. Moreover, struggles with household tasks often lead to major lifestyle changes such as an increased dependence on prepared food services resulting from the physical incapacity to cook [21].

Statistics confirm these observations: longitudinal tracking shows that daily life continues to be disrupted for over 15% of individuals at the 12-month recovery mark [8].

7.2 Work and Productivity

The burden of ongoing cognitive challenges in long COVID significantly compromises an individual's capacity to sustain employment. Problems such as slowed mental processing and memory loss can hinder a patient's ability to return to the workforce. This is especially critical for medical professionals like surgeons and first responders, who rely on quick thinking to perform their jobs effectively [11]. The extent of the issue is further underscored by a large-scale analysis, which observed attention deficits in approximately 24% of a group of 6,911 patients [10].

Many individuals are forced to change their employment status due to reduced productivity. A study by Ariza reported that 44.7% of Post-COVID Condition patients experienced job changes attributable to the disease. This issue spans all labor categories; even those in high-skill professions struggled to maintain performance, leading to lower productivity and, in some cases, resignation or demotion [16].

The toll on both finances and careers is severe, with many individuals describing how difficult it is to meet the demands placed on them by employers. For example, the push to return to the office can be insurmountable for those physically unable to manage the commute or strict schedules. This often results in lost income and a difficult search for flexible jobs that can accommodate their condition [21]. SARS-CoV-2 positive patients were also far more likely to miss over 10 days of work than those who tested negative (59% vs. 36%) [20].

The struggle to return to full-time employment often triggers a cycle of worsening health and prolonged leave, resulting in significant economic strain and an inability to return to former activity levels. The effects extend well beyond the workplace, severely impacting daily well-being by disrupting sleep, diminishing appetite, and restricting physical activity [16,21].

8. Management Strategies

8.1 Cognitive and Behavioral interventions

For best results, cognitive and behavioral care should be proactive and begin while the illness is still acute. Interventions such as early mobilization are recommended to enhance functional, cognitive, and respiratory status, a practice which may also serve to reduce the duration of hospitalization [1]. With over a quarter (27.1%) of patients showing signs of cognitive impairment, treating these deficits is a matter of great importance [10].

To manage the condition effectively, clinicians must identify deficits early on; this allows for timely cognitive rehabilitation and helps avoid complications caused by inappropriate medication use. Healthcare workers are essential in this process, as identifying cognitive impairments early allows them to provide tailored advice that improves both patient understanding and treatment outcomes [19]. It is also essential to implement interventions that build cognitive reserves. To improve recovery in Post-COVID patients, it is essential to implement interventions like exercise, nutrition, and cognitive training that specifically target neuroplasticity [16].

8.2 Emerging Neuromodulatory and Experimental Therapies

New therapeutic strategies seek to resolve the underlying etiologies of Post-COVID-19 Condition rather than merely managing symptoms. Consistent with the hypothesis of neuropeptide dysregulation, pharmacological blockade of specific receptors using agents such as naltrexone and aprepitant has demonstrated clinical efficacy in ameliorating pain and neurological sequelae in survivors [24]. Standard clinical practice for symptom control frequently involves the use of antidepressants (31%), benzodiazepines (19%), or gabapentin (11%). The therapeutic approach is broad, often extending to antivirals like valacyclovir, steroids such as prednisone, and stimulants like modafinil [20].

8.3 Multidisciplinary Care and Long-Term Follow-Up

Because long COVID is a complex condition, it requires the expertise of a multidisciplinary team [20]. A critical part of this care involves making mental health support readily available, screening patients during check-ups, and referring them to specialists when needed [1]. Moreover, because depression often worsens cognitive issues, personalized exercise plans that target both physical and psychological health can play a vital role in enhancing well-being [27].

Because they serve as the primary entry point for care, outpatient and primary care clinicians must be prepared to navigate the diverse clinical challenges associated with PCC. Patients with significant symptoms often benefit from formal evaluations that help decide between cognitive rehabilitation or drug therapies [28]. Monitoring high-risk individuals should be maintained over the long term [19]. For younger patients and essential workers, early cognitive testing is a valuable tool that helps determine the extent of their condition and supports their return to the workplace [11].

Strategically, understanding the epidemiology of symptoms is vital for guiding resource distribution and innovation in therapy [18]. Rapid prevention and intervention are key to reducing chronic risks. Long-term monitoring and cross-disciplinary research are also needed to track how symptoms change over time [8,13]. Finally, clinicians must carefully distinguish long COVID from chronic illnesses and investigate how virus variants and infection severity affect neurological outcomes [22].

9. Future Directions

Although evidence on post-COVID cognitive impairment is steadily growing, several essential questions remain unanswered. A more unified approach to recognising post-COVID cognitive symptoms is urgently needed, as the lack of shared terminology and diagnostic criteria leaves patients without clear classification or clinical guidance. Agreeing on standard definitions would also improve comparisons across studies and strengthen the quality of future research [17].

A major priority is improving how cognitive impairment is assessed. Future studies should combine structured neuropsychological tests with neuroimaging and biomarker measures. Reviews call for standardised cognitive protocols and routine biomarker use [19]. Imaging studies, including microvascular techniques such as 3C-IVIM, may also help detect early brain changes before measurable decline [15]. Clinical data further show that routine inflammatory and autoimmune markers do not distinguish symptomatic patients from controls, pointing to the need for more sensitive immune-based tools such as T-cell assays [20]. According to Ariza et al., creating a precise risk profile requires a combination of blood markers and neuroimaging, and it is equally important to study how these cognitive deficits develop and evolve in the long term [16].

Further research should also address gaps in cognitive profiling, especially understudied areas such as language and communication, and clarify how symptom patterns change over time [16,19,21]. Work is also needed to understand why some individuals are more vulnerable to persistent cognitive symptoms, including possible differences across ethnic groups [21,22].

A systematic review of cognitive interventions in long COVID indicates that cognitive training, cognitive-behavioural therapy and multicomponent rehabilitation programmes can alleviate cognitive symptoms and support everyday functioning [29]. As the evidence is still limited, rigorous future trials are needed to determine which targeted neuropsychological rehabilitation strategies and approaches strengthening cognitive reserve are most effective in patients with persistent post-COVID cognitive impairment [11,16].

10.Conclusions

Despite the widespread recognition of post-COVID cognitive deficits, significant gaps persist regarding standardized diagnostic criteria and treatment strategies. This lack of standardized definitions results in missed diagnoses and hinders research comparisons, pointing to an urgent need for a shared medical vocabulary. Improving assessment practices will require combining structured neuropsychological testing with neuroimaging and biomarker-based approaches to better characterise early brain changes and identify individuals at risk of persistent deficits.

Understanding the spectrum of cognitive difficulties also demands focused investigation of understudied domains, particularly language and communication, and closer examination of how symptom patterns evolve over time. Greater representation of diverse populations is essential to capture global variability and ensure that emerging conclusions are broadly applicable.

Early therapeutic data are encouraging. Reviews of cognitive interventions in long COVID shows that cognitive training, cognitive-behavioural therapies, and multicomponent rehabilitation programmes can improve cognitive performance and support daily functioning. Current evidence remains sparse, with most studies limited by small samples and variable methodology. More robust, well-designed trials are required to clarify which forms of neuropsychological rehabilitation and strategies aimed at strengthening cognitive resilience yield the most meaningful clinical improvement in persistent post-COVID cognitive symptoms.

Ultimately, progress in this field depends on creating consistent diagnostic standards, better understanding patient biology, and proving the effectiveness of new treatments. Such efforts will lay the foundation for superior clinical care and better long-term recovery for those suffering from the cognitive aftereffects of COVID-19.

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