



Health Complications in Patients Recovering from COVID-19: A Narrative Review of Post-COVID Syndrome

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Authors' contributions

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ABSTRACT

Introduction: Due to the unprecedented health and economic complications resulting from COVID-19, the coronavirus pandemic is currently a leading global health concern. COVID-19 poses significant health risks, life-threatening clinical conditions, and even mortality in affected individuals. Several associated complications have also arisen as a result of COVID-19, including mass hospitalization, the need for invasive ventilation and intensive care unit (ICU) support, delayed recovery from infection, and post-recovery health issues. Furthermore, the pandemic itself has created enormous panic, which in turn affects the mental health of COVID-19 patients, individuals who have recovered from the disease, and the general population. Just over a year has now passed since the beginning of the global COVID-19 pandemic and in this

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time, over 110 million individuals have been infected worldwide. Post-infection recovery times and long-term complications are now becoming more apparent. Especially physical and mental health complications arising from post-COVID-19-infection, which prevent a return to a healthy lifestyle and everyday routine remain a critical issue.

Objective: The primary objective of this narrative review is to address this clinically relevant issue and overview the health complications commonly observed in individuals who have recovered from COVID-19.

Methods: An investigation was performed on online databases for relevant articles from 2020 until January 2021. Key index words used in search were post-covid, myalgia, fatigue, pain.

Results: Fatigue, myalgia (i.e., muscle pain), sleep disruptions, and mental health issues (e.g., anxiety and depression) are among the most reported post-recovery symptoms in patients recovering from the disease. The etiology and potential management of these health complications are discussed, considering recently published findings from COVID-19 patients as well as previous studies focusing on complications arising from other related pandemics.

Conclusion: Patients who have recovered from COVID-19 should be evaluated for signs of fatigue, muscle pain, mental health difficulties, and sleeping difficulties regardless of disease severity. Based on this review of the literature, complete clinical and psychiatric evaluation, and the use of validated indicators of the severity of COVID-19 disease, symptoms are recommended to develop efficient health management approaches that meet patients' needs.

Keywords: COVID-19; fatigue; insomnia; mental health; myalgia.

1. INTRODUCTION

The coronavirus disease identified in 2019 (COVID-19) is instigated by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and is currently a public health emergency of international concern [1]. Over a year into the global pandemic, more than 110 million COVID-19 cases have been confirmed worldwide, with global mortality rates surpassing 2.5 million people in early 2021 [2]. Millions have also been infected with the virus, but remain undiagnosed because of asymptomatic presentations (i.e., suspected COVID diagnoses; 41). The most commonly reported symptoms of COVID-19 infection include headache, fever, fatigue, shortness of breath, cough, anosmia (loss of smell), myalgia (muscle pain), and joint pain [3-6]. COVID-19 outpatients require several weeks to completely recover from disease manifestations; approximately one-third of patients do not return to their usual state of health until approximately 2 to 3 weeks after diagnosis [7].

Post-COVID syndrome (also known as Long COVID) has been reported in several studies and represents chronic, long-lasting symptoms, including fatigue, myalgia, insomnia, and mental health issues in COVID-19 patients after recovery from primary infection symptoms [8,1]. The prevalence of health complications following recovery from COVID-19 infection ranges from 20% to 76% of patients diagnosed or suspected

to be infected with COVID-19 [9,1,10]. However, these figures are from heterogeneous populations, study designs, and time periods used. Such conditions have been shown to continue for longer than 12 weeks after the onset of acute symptoms [9] and emphasize the need for continued patient care to avoid further health issues. Concerns have been raised regarding the potential long-term complications of chronic fatigue syndrome (CFS) in COVID-19 patients, with functional impairment continuing for an extended period post-recovery [11]. Furthermore, most patients report persistent COVID-19-related symptoms: 32% of COVID-19 patients have one or two symptoms, and 55% of patients have three or more symptoms 60 days after diagnosis [12]. In contrast, only 13% of patients were clear of all COVID-19-related symptoms two months after diagnosis. Although the disease is reported to be more severe in older adults (aged 65+), one out of every five young patients (aged 18 to 34 years) with no pre-existing conditions experience difficulties returning to normal health in the two–three weeks following COVID-19 infection [7]. In non-hospitalized patients, 31% of adults aged 33 – 53 depend on others for care at 3 months post-COVID [13].

Muscle weakness and rigidity, CFS, exhaustion, and sleep disorders (e.g., insomnia, REM sleep behavior disorder) are the most common chronic symptoms observed in patients post-COVID-19-recovery [14]. There has not been sufficient time to study and understand the long-term impacts

and implications of COVID-19 in depth since the beginning of the pandemic; however, recent studies have identified substantial and long-term adverse health effects. No standard clinical definition of Post-COVID syndrome exists yet [13]. Long-term effects and symptoms could be related to immune-system-related inflammation, an exaggerated auto-immune response, or dysautonomia due to dysregulation of the autonomic nervous system [15].

This review explores the various long-term health complications resulting from COVID-19 and discusses the underlying causes and potential management approaches for these symptoms. The broad goal of this review is to bring awareness to the long-term diagnosis and management of post-recovery COVID-19 symptoms for patients and health care professionals.

2. METHODOLOGY

An investigation was performed on the online databases Pubmed and Scopus for articles in the English language literature on health complications of patients recovering from COVID-19. The search strategy initially employed the use of free words and Medical Subject Headings (MESH) terms: "SARS-CoV-2" OR "coronavirus-19" AND "myalgia", "fatigue", "anxiety", "insomnia" and "pain". Studies fulfilling the following inclusion criteria were considered eligible for inclusion in this study: (i) performed on human subjects, (ii) published in 2020-January 2021. The manuscript titles list was highlighted to exclude irrelevant publications and search errors. The final selection was performed after reading the full texts of the papers.

3. HEALTH COMPLICATIONS IN PATIENTS RECOVERING FROM COVID-19

The first UK-based research study on post-COVID-19 recovery found that 60.0%–72.0% of patients reported fatigue as the most frequent ongoing complication [16]. Shortness of breath (42.6% - 65.6%) and psychiatric depression (23.5% - 46.9%) appear to be the next most prevalent symptoms and are related to insomnia and myalgia [17,18,19,15,20]. Although many patients fully recover, health complications can delay a person's complete return to a regular

lifestyle. Some of these complications are described and discussed in this article.

3.1 Fatigue

Chronic fatigue syndrome (also termed myalgic encephalomyelitis) is a typical feature of most viral and bacterial infections [15]. A multidimensional physical issue related to shortness of breath, sleeping disorders, and psychological problems such as memory loss and "brain fog" [16], fatigue is a common problem experienced by patients with viruses similar to COVID-19 (e.g., SARS, Ebola; 37). For instance, 40.3% of patients who had recovered from SARS experienced CFS four years later [21]. High rates of post-viral fatigue have also been reported in patients recovering from Ebola virus infection [22].

Thus, it is not surprising that CFS is the most common symptom of COVID-19 [7,23-25]. Fatigue is experienced by a substantial percentage of individuals who have recovered from COVID-19 infection [24], with 71.0% to 87.4% of patients reporting fatigue or shortness of breath two–three months after full recovery from infection [25].

Despite the prevalence of fatigue symptoms throughout the clinical population, the etiology of fatigue in relation to COVID-19 infections remains largely unknown. Some studies have demonstrated that women are more prone to experiencing long-term fatigue following COVID-19 recovery [23]. Patients with co-existing depression or anxiety also suffer from post-COVID fatigue longer than healthy individuals without psychiatric conditions [15,26]. As mentioned above, breathlessness or shortness of breath has been identified as a significant cause of fatigue [27] and is also related to the need for ICU admission and respiratory assistance, comorbid lung conditions, older age, and obesity [28].

There is currently no evidence assessing the potential direct associations between acute COVID-19 severity and fatigue after recovery from COVID-19 [24]. There is also a lack of research on inflammation markers, changes in cell counts, and pro-inflammatory agents with post-COVID-19 fatigue [28]. These are important research areas because central factors such as neurotransmitter levels, inflammation, and intrinsic neuronal excitability might contribute to COVID-19 fatigue [23]. Recent evidence shows that SARS-CoV-2 can enter nerve cells and the

central nervous system, provoking a virus-mediated immune response [29].

One particular avenue that might prove fruitful for researchers and health care professionals relates to a recent hypothesis that CFS may be caused by olfactory neuron impairment, resulting in lower cerebrospinal fluid outflow through the cribriform and subsequent flooding of the glymphatic network of the central nervous system [11]. As such, cerebrospinal fluid drainage has been recommended for patients with post-infection CFS to reinstate glymphatic transport and waste elimination throughout the central nervous system, although further research is needed to validate these recommendations. Investigations into the cytokine networks of patients recovered from COVID-19 are also necessary to evaluate the role of protein disruptions associated with both post-infectious CFS and COVID-19 (including Interleukin-2 and interferon- γ inducible proteins) in long-term fatigue [15].

3.2 Myalgia

Myalgia (i.e., muscle pain) is another commonly reported long-term complication among individuals who have recovered from COVID-19, with 14.8% of patients suffering from long-term myalgia [30]. Many patients affected by COVID-19 have been hospitalized throughout this pandemic, with many requiring admission to the ICU due to respiratory failure or oxygen insufficiencies. ICU procedures and invasive treatment options (e.g., being placed on a ventilator to support weakened lung function) may result in myalgia, peripheral neuropathy, or chronic pain due to the stresses placed on the human body [31]. Life support interventions and ventilation support (e.g., ECMO) can also lead to delirium and neuropathies in patients, even after short-term implementation [32].

Physical movement might also be restricted (and even limited to bed rest in some cases) for patients being treated for COVID-19, especially for patients admitted to a hospital or ICU. Generally, prolonged immobility and bed rest lead to muscular myopathy and atrophy, culminating in muscle deconditioning (often termed as 'ICU-acquired muscle weakness') in long-term hospital patients [33]. Long-term immobilization also results in the loss of up to 2% of the lean body mass each day, causing impaired balance and coordination together with

joint rigidity [34]. Therefore, it is critical that healthcare professionals continuously monitor and treat muscle weakness in patients with COVID-19 throughout their hospital stay or outpatient recovery.

The exact mechanism of myalgia post-viral infection is unknown. Central sensitization and hyper-responsivity to pain have been identified as the primary pathophysiological etiologies of myalgia and CFS [35,36]. Some studies have discussed whether SARS-CoV-2 can affect skeletal muscle cells by binding with ACE2 alone or with other pro-inflammatory cytokines, resulting in cell damage and expression of growth factors, with excessive stimulation of the dorsal root ganglia [37].

SARS-CoV-2 intensifies catabolism, resulting in protein degradation and low muscle development and regeneration [35,38]. Short- and long-term musculoskeletal complications are anticipated in patients recovering from moderate to severe COVID-19 symptoms. As such, researchers have proposed that COVID-19 outpatients would likely benefit from physiotherapy and rehabilitation programs similar to those offered to patients recovering from SARS [39], as myalgia and fatigue from Long Covid do not appear to respond as well to classic analgesics [37].

3.3 Mental Health

Pandemic-related mental health consequences are prevalent and affect most of the global population, although it is becoming increasingly evident that long-term mental health issues are exacerbated in patients who have contracted the disease. Two separate studies have reported adverse effects of COVID-19 on patients' mental health, with 16%–18% of respondents developing depression and anxiety in response to the pandemic [17,15]. Neuropsychological symptoms such as post-traumatic stress disorder (PTSD) were reported more frequently by females and younger adults, and 74% of participants in a British study who reported higher levels of anxiety and depression post-COVID-19 had no previously diagnosed mental health condition [16,40]. Disease severity (e.g., outpatient, hospitalization) is directly associated with negative psychological impacts, such that 38.5% of men and 76.9% of women who required hospitalization in the ICU experienced more significant levels of anxiety, depression, and breathlessness at 4 to 8 weeks post-

recovery than patients who recovered at home [16].

Critically, many people with no personal history of psychiatric disorders before the pandemic develop clinical-level mental health concerns (particularly in relation to anxiety disorders or major depressive disorder) during treatment, recovery, and post-recovery from contracting COVID-19. For example, 74.0% of patients suffering from anxiety and depression post-COVID-19-infection did not have a designated mental health disorder before contracting the virus [16]. Pandemic-related stress is also related to mood dysregulation in patients with severe psychosocial issues (e.g., anxiety and acute panic) and has also been shown to elevate psychological distress and suicidal tendencies [41,42]. At the neural level, the limbic system is recognized as one of the leading subcortical networks responsible for emotion and mood regulation. However, centrally sensitized individuals who have recovered from COVID-19 show evidence of limbic system dysfunction [16], which has led researchers to propose that acute exacerbations of depression and anxiety symptoms in these patients may be caused by underlying neural activation patterns [43].

Chronic psychiatric disorders, such as anxiety disorder, depression, and posttraumatic stress disorder, have also been directly associated with delayed recovery and restoration of everyday life [7]. Social isolation protocols inherent to many COVID-19 treatments can also aggravate mental health issues, particularly depression, anxiety, and delirium [41]. Consequently, the mental well-being of patients infected with COVID-19 is significantly impacted, delaying their overall recovery.

In light of the significant mental health impacts on patients who have lived through COVID-19 infection, it is recommended that ongoing psychological screening, support, and psychotherapy be provided to patients in inpatient and outpatient settings [17,44]. Notably, while many patients may benefit from individual psychotherapy, group- and population-based interventions will also be a necessary part of treatment given the extent of the health crisis and its large-scale psychological consequence [40]. In particular, peer-support groups and group-based therapies will be essential in helping individuals overcome mental health struggles with social reintegration and a general sense of

knowing that they are not alone. There is not enough research yet to evaluate the effectiveness of online therapy treatments, as the quality of relationship and absence of body-to-body and eye contact interaction is compromised [45].

3.4 Sleep Disorders and Insomnia

Disruptions in sleeping habits and patterns, including hypersomnia (sleeping for longer durations than average) and insomnia (disruptions in the ability to stay or fall asleep), are commonly observed among patients with mood and anxiety disorders [46] and have also been identified as one of the primary long-term health consequences of COVID-19 [47,48]. Abnormalities in sleeping patterns have been reported for the public at large [46] and patients recovering from COVID-19 infection [48]. A large-scale investigation of the sleep and mental health conditions of the general Chinese public revealed the persistence of depression (24.5%), insomnia (20.0%), anxiety (18.5%), and acute stress (15.8%) for a few months into the COVID-19 pandemic [47].

Atypical sleeping habits are related to several health complications, such as emotional distress and increased stress responsivity [49,34]. In relation to COVID-19, patients who have recovered from the virus report persistent sleeping disruptions (e.g., insomnia, nightmares) and experience non-restorative sleep, marked by rapid-eye-movement-related apneas and alpha wave readings, which occur in central areas and indicate physiological, brief states of awakening between wakefulness and sleep [47]. Restorative sleep is required for patients to recover from the virus completely; however, physical pain, anxiety, and mental distress lead to disruptions in sleep patterns [50]. COVID-19 patients also experience insomnia due to shortness of breath and low blood oxygen levels, indicating prolonged susceptibility to chronic lung diseases and neurological complications with ongoing sleeping difficulties [47,51].

Sleeping disorders pose a significant risk for exacerbating mental health issues and other long-term complications such as hypertension, diabetes, and obesity. Furthermore, it is essential to consider that acute (short-term) insomnia can lead to chronic (long-term) sleep disorders if left untreated [52]. Thus, it is imperative that the degree of sleep disruption and impairment in daily functioning is also monitored in order to

Table 1. Analysis of the data obtained pertaining to the health complications in patients recovering from COVID-19

Sr. No.	Complication	Author	Year of publication	Country	Population evaluation and methodology	% of Population Affected	Conclusion of the study
1.	Fatigue	Tenforde, M.W.; Kim, S.S.; Lindsell, C.J.; et.al.	July, 2020	United States	Telephone interviews, with a random sample of adults aged ≥ 18 years who had a first positive reverse transcription-polymerase chain reaction (RT-PCR) test for SARS-CoV-2, the virus that causes COVID-19, at an outpatient visit at one of 14 U.S. academic health care systems in 13 states. Interviews were conducted 14-21 days after the test date.	Among 292 respondents, 94% (274) reported experiencing one or more symptoms at the time of testing; 35% of these symptomatic respondents reported not having returned to their usual state of health by the date of the interview (median = 16 days from testing date), including 26% among those aged 18-34 years, 32% among those aged 35-49 years, and 47% among those aged ≥ 50 years. Among respondents reporting cough, fatigue, or shortness of breath at the time of testing, 43%, 35%, and 29%, respectively, continued to experience these symptoms at the time of the interview.	These findings indicate that COVID-19 can result in prolonged illness even among persons with milder outpatient illness, including young adults.
2.	Fatigue	Islam, M.F.; Cotler, J.; Jason, L.A	June, 2020	United States	NA	NA	Population suffering from either viral or bacterial diseases, either pandemic or non-pandemic, shows symptom of fatigue.
3	Fatigue	Townsend L, Dyer AH, Jones K, Dunne J, Mooney A,	October, 2020	Ireland	The study was carried out in the post-COVID-19 review clinic at St James's Hospital (SJH), Dublin, Ireland. 223	Fatigue was assessed using the CFQ-11 in all participants and the mean (\pm SD) score was 15.8 \pm 5.9 across the study population. The mean physical	COVID-19 appears to result in symptoms of severe fatigue that outlast the initial acute

Sr. No.	Complication	Author	Year of publication	Country	Population evaluation and methodology	% of Population Affected	Conclusion of the study
		Gaffney F, et al.			patients were offered an outpatient appointment, of which 128 (57%) attended for assessment. Participation had to occur at least 6 weeks after either: (i) date of last acute COVID-19 symptoms (for outpatients) and (ii) date of discharge for those who were admitted during their acute COVID-19 illness.	fatigue score (\pm SD) was 11.38 ± 4.22 , while the mean psychological fatigue score (\pm SD) was 4.72 ± 1.99 . Based on the CFQ-11 case definition, 52.3% (67/128) met the criteria for fatigue, with the mean (\pm SD) CFQ-11 score in this group being 20 ± 4.4	illness. Most interestingly, fatigue was not associated with initial disease severity. A lengthy post-infection fatigue burden will impair quality of life and will have significant impact on individuals, employers and healthcare systems.
4.	Fatigue	Halpin SJ, McIvor C, Whyatt G, Adams A, et. al.	July 2020	University of Leeds, Leeds, UK	A purposive sample of 100 survivors discharged from a large University hospital was assessed 4 to 8 weeks after discharge by a multidisciplinary team of rehabilitation professionals using a specialist telephone screening tool designed to capture symptoms and impact on daily life.	Participants were between 29 and 71 days (mean 48 days) post discharge from hospital. New illness-related fatigue was the most common reported symptom by 72% participants in the ICU group and 60.3% in the ward group.	New illness-related fatigue was the most common reported symptom by 72% participants in ICU group and 60.3% in ward group.
5.	Myalgia	CAN NU, Özgecan KA, Kotan D.	Nov. 2020	Turkey	One hundred ten patients diagnosed with COVID-19 in our hospital were included retrospectively in this study. Presence of	Fifty patients (45.5%) had muscle pain at the time of admission High CK results were obtained in 48 (43.6%) of the 110 patients at	Since some patients may only present with musculoskeletal symptoms such as myalgia, it is

Sr. No.	Complication	Author	Year of publication	Country	Population evaluation and methodology	% of Population Affected	Conclusion of the study
					myalgia at the time of admission and on the 14th day of control were investigated. The first admission laboratory findings, 3rd day CK values and 14th day control CK values of all patients were recorded retrospectively from their files.	the time of admission. Thirty-two (66.7%) of 48 patients with high CK had muscle pain	important that clinicians consider and evaluate COVID-19 in patients presenting with myalgia and high CK levels
6.	Mental Health	Gautam, K.; Adhikari, R.P.; Gupta, A. Sen, et. al.	December, 2020	Nepal	Data were collected through social media from 2082 Nepalese respondents between 23rd April, 2020 and 3rd May, 2020 since Facebook which is the widely used social media in Nepal has an extensive reach to a large number of respondents. A total of 2014 respondents who were currently residing in Nepal were included in the analysis.	More than one third (35%) of the respondents reported anxiety and worry in the last 2 weeks, while around one-third (32.2%) suffered from two or more symptoms of psychological distress such as restlessness, fearfulness, anxiety and worry, and sadness.	Conclusion of the study It is important to recognize and acknowledge the immediate short and longer-term mental health and psychological consequences of the current crisis. The demand for mental health and psychosocial support services is likely to escalate in the near future. Thus, health care providers should be prepared in advance to face the upcoming challenges.

Sr. No.	Complication	Author	Year of publication	Country	Population evaluation and methodology	% of Population Affected	Conclusion of the study
7.	Mental Health, sleep disorder and insomnia	Morin CM, Carrier J.	January, 2021	Canada	The few published studies on this topic focused primarily on health-care workers	Higher rates of insomnia (34%–36%), anxiety (45%) and depressive symptoms (50%) among those individuals relative to the general population. Moreover, the data suggested a 37% increase in the rates of clinical insomnia (from 14.6% to 20%) from before to peak of COVID pandemic.	Because sleep disturbances such as insomnia and nightmares may persist well after the pandemic, and such problems are often precursors of psychiatric disorders, individuals who develop sleep disturbances during COVID-19 may be at greater risk for long-term adverse outcomes.
8.	Sleep disorders and insomnia	Lin, L. yu; Wang, J.; Ou-yang, X. yong; Miao, Q., et. al.	June 2020	China	The data were collected through an online questionnaire with a sample of 5461 individuals in China from February 5, 2020, to February 23, 2020.	A total of 1042 (18.47%) participants were suspected of having generalized anxiety disorder. A total of 892 (15.8%) of the participants had ASD according to the ASDS, with an average score of 27.94 ± 10.79 . only 14.64% (826) of individuals had clinical insomnia during the last quarter of 2019.	The results indicated that insomnia is more severe in people who are female, young, living in the epicenter and experiencing a high degree of threat from COVID-19.
9.	Complication	Sher, L.	2020	China	Review	Researchers in China examined psychological responses during the initial stage of the COVID-19 epidemic in the general population. They found that	Sleep disturbances are associated with anxiety, depression, and suicidal behavior. Sleep

Sr. No.	Complication	Author	Year of publication	Country	Population evaluation and methodology	% of Population Affected	Conclusion of the study
						53.8% of respondents rated the psychological impact of the outbreak as moderate or severe, 16.5% reported moderate to severe depressive symptoms, and 28.8% reported moderate to severe anxiety symptoms. This data was based on the article Wang et al. [54].	abnormalities are a stand-alone risk factor for suicidal ideation, suicide attempts, and suicide death. Appropriate treatment of sleep disturbances is always vital and reduces symptoms of psychiatric disorders and suicidality. However, recognizing and treating insomnia are especially important during stressful times such as the COVID-19 epidemic because it may significantly reduce suicides.

Abbreviations: N/A – Not applicable

prevent or pre-emptively treat long-term complications in patients affected by COVID-19 [47,22], as well as the general population.

Self-care and symptomatic treatment approaches are encouraged in patients with post-viral syndromes [51]. As such, large-scale sleep education practices are particularly essential in creating and promoting public awareness of healthy sleeping practices. Individualized treatment plans for patients experiencing persistent pervasive disruptions in sleeping patterns will also be necessary to help individuals re-establish a healthy sleeping lifestyle. It is recommended that individuals experiencing chronic insomnia or long-term sleeping difficulties should maintain healthy sleep hygiene practices such as having dark and relaxing bedrooms that are only used for sleeping (e.g., moving desks to another room in the house, eliminating electronic devices that emit light), establishing a regular sleep schedule, maintaining comfortable room temperatures, avoiding coffee and alcohol after dinner, and engaging in regular exercise [53]. In severe cases where maintaining healthy sleep hygiene habits does not improve sleeping patterns, it is recommended that patients be referred to psychiatric and sleep health specialists so that targeted cognitive-behavioral therapy and prescription treatments (e.g., melatonin, antidepressants, sedatives) can be determined based on patient needs [52].

4. DISCUSSION

The COVID-19 virus is the most pressing public health concern worldwide, and the associated pandemic has resulted in significant physiological and psychological impacts for the general public and patients who have recovered from COVID-19 infection. Patients continue to experience a range of symptoms for months after recovery [51,23], and many patients who have never suffered severe health issues before the pandemic experience long-term psychiatric and physiological problems after being hospitalized for COVID-19 [55,19].

Due to this virus's novelty, the etiology and long-term effects of these health complications are still not well understood. Variable clinical manifestations and mechanisms may occur, either due to direct viral damage or an autoimmune or neurological response [12]. It also remains unclear how variants of the COVID-19 virus may differentially impact patients' recovery times and symptomologies. However,

physical, psychological, and financial stress factors can directly affect the central sensitization process, resulting in neuroplastic alterations in the chemical, structural, and functional features of the brain and changes in the central nervous system's response to pain and other peripheral noxious stimuli [56]. Long-term muscle pain, fatigue, headache, and other physical distress also negatively impact a person's psychological state, leading to clinical anxiety, depression, suicidality, or sleep disruptions [57]. Therefore, it is likely that all of these factors are interdependent and should be addressed according to inpatient treatment programs.

Several studies have suggested the combined involvement of multidisciplinary rehabilitation team care to combat complications [58,55,59,5]. It is also essential to recognize that although clinical settings provide high standards of medical support for inpatients, prolonged isolation from friends and family, as well as pandemic and health-related panic urgently, demands co-occurring psychological support for patients to ensure the immediate improvement of mental health outcomes and eventual restoration of physical health [20]. Psychological and physical therapy monitoring programs should also follow patients recovering at home and once patients leave the inpatient settings. Various online support groups and agencies designed for patients suffering from long-term COVID complications have been created (such as Your COVID Recovery by the NHS) and provide new avenues for developing and designing interventions moving forward. These groups support COVID-19 patients and their families [60].

Long-term statistics regarding various clinical manifestations and reference classes in a significant COVID-19 patient population are currently unavailable. However, long-term, uncertain consequences are anticipated to occur in many patients who contract the virus [55]. Prospective longitudinal observational research and clinical follow-up interventions are crucial to properly understand the duration and complexity of health issues experienced following recovery from COVID-19 and to compare symptom recovery with other diseases of similar etiology.

5. CONCLUSION

Based on an overview of recent research evaluating long-term health effects following

recovery from COVID-19 infection, this narrative review concludes that patients who have recovered from COVID-19 should be re-evaluated for signs of fatigue, muscle pain, mental health difficulties, and sleeping difficulties regardless of disease severity. Given the worldwide extent of this pandemic, it is also imperative to design clinical studies that consider ethnic and socio-demographic differences in patient symptoms and recovery trajectories to establish practical management approaches for post-COVID complications. Collaboration between department specialists and a complete clinical and psychiatric work-up, including validated evaluations and symptom severity indicators, is recommended to improve our understanding of the disease's long-term trajectory. Associations between immune-compromising risk factors (e.g., age, diabetes, cardiovascular disease, obesity, and drug addiction) and long-term complications from COVID-19 infection must be explored in future investigations and clinical trials. Relatively affordable and practical methods are needed to treat post-viral symptoms (e.g., conservative rehabilitation) and improve patients' quality of life and reduce the impact of the pandemic on our society.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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