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POST-COVID SYNDROME: NEUROCOGNITIVE AND MENTAL HEALTH IMPLICATIONS IN ADULTS AND THE ROLE OF METACOGNITIVE PSYCHOTHERAPY AND NEUROGYMNASTICS

Abstract. This article addresses the long-term consequences of COVID-19, commonly referred to as “post-COVID syndrome,” which encompasses a wide range of neurocognitive and mental health disturbances persisting for weeks or months beyond the acute infection. Prominent among these are memory deficits, attentional impairments, and executive dysfunction, alongside psychiatric manifestations such as anxiety, depression, and post-traumatic stress disorder. The discussion underscores that even so-called “brain fog,” which may not always be verified by objective testing, significantly degrades quality of life and necessitates a comprehensive approach to rehabilitation.

The article delves into key factors influencing the trajectory of post-COVID syndrome. These include neuroinflammatory processes, dysregulated immune responses, and vascular complications, as well as psychosocial factors linked to pandemic-related stress and isolation. The authors highlight that prolonged uncertainty about recovery can exacerbate anxiety, fatigue, and cognitive impairments, underscoring the importance of holistic, non-pharmacological strategies in post-COVID care.

Metacognitive psychotherapy emerges as a promising intervention aimed at identifying and correcting ineffective cognitive strategies, such as excessive worry or rumination, which can intensify symptom severity. Techniques like Attention Training and Detached Mindfulness help mitigate cognitive load and reduce internal stress. In parallel, the article presents neurogymnastics—a structured set of cognitive and physical exercises—as another key element. By stimulating neuroplasticity and fostering the renewal of disrupted neural pathways, neurogymnastics may strengthen executive functions and enhance overall cognitive resilience in individuals recovering from COVID-19.

Emphasis is placed on personalized treatment protocols that account for varying degrees of cognitive impairment, comorbidities, and emotional states. The role of telehealth is also discussed, given that online delivery offers both continuous

engagement and flexibility in scheduling, particularly crucial for patients with limited access to healthcare facilities.

Finally, the authors call for further research, including long-term, randomized controlled trials, to refine methods of metacognitive psychotherapy and neurogymnastics. Determining the optimal “dose” of such interventions and evaluating their synergy with other recovery measures will be critical for maximizing rehabilitation outcomes. A more integrated, evidence-based model could substantially improve quality of life for those experiencing post-COVID syndrome, offering a multifaceted and dynamic path toward cognitive and emotional restoration.

Keywords: post-COVID syndrome, neurocognitive impairments, mental health, metacognitive psychotherapy, neurogymnastics, telehealth, cognitive functions, anxiety, depression.

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ПОСТ-COVID СИНДРОМ: НЕЙРОКОГНІТИВНІ НАСЛІДКИ У ДОРОСЛИХ, РОЛЬ МЕТАКОГНІТИВНОЇ ПСИХОТЕРАПІЇ Й НЕЙРОГІМНАСТИКИ

Анотація. У статті розглядаються довгострокові наслідки COVID-19, що отримали назву «пост-COVID синдром», і охоплюють широку низку нейрокогнітивних та психічних розладів, які зберігаються або виникають у пацієнтів через кілька тижнів чи місяців після одужання від гострої форми захворювання. Серед найбільш поширених порушень виділяють проблеми з пам'яттю, увагою й виконавчими функціями, а також стани тривоги, депресії та посттравматичного стресового розладу. У роботі акцентується, що навіть так званий «туман у голові» (brain fog), який може не підтверджуватися об'єктивними тестами, суттєво погіршує якість життя та вимагає комплексного підходу до відновлення.

Значне місце відведено аналізу чинників, що впливають на прогресування пост-COVID синдрому. До них належать нейрозапальні процеси, порушення регуляції імунної системи та впливи судинного характеру, а також психосоціальні фактори, пов'язані зі стресом та ізоляцією під час пандемії. Автори звертають увагу на те, що затяжний перебіг відновлення й невизначеність прогнозу часто призводять до формування стійкого відчуття тривоги, перевтоми та зниження когнітивних можливостей. У цьому контексті важливо розглядати комплексні немедикаментозні стратегії реабілітації.

Одним із перспективних підходів є метакогнітивна психотерапія, спрямована на виявлення та корекцію неефективних розумових стратегій, таких як надмірне занепокоєння чи румінації, що можуть посилювати симптоматику. Використання технік уваги (Attention Training) й відстороненого усвідомлення (Detached Mindfulness) дає змогу послабити когнітивне навантаження й знизити рівень внутрішнього стресу. Паралельно з цим, у статті обґрунтовується застосування нейрогімнастики — комплексу вправ, що поєднують пізнавальну та рухову активність. Показано, що така інтегрована методика підтримує нейропластичність, стимулює відновлення порушених нейронних зв'язків і підвищує загальну когнітивну витривалість.

Автор підкреслює, що ефективність вказаних програм реабілітації значно зростає за умови індивідуалізованого підходу, який враховує ступінь тяжкості початкових когнітивних порушень, наявність супутніх захворювань та особливості психоемоційного стану пацієнтів. Значну увагу приділено також питанням телереабілітації, оскільки онлайн-формат дозволяє продовжувати терапію навіть за умов обмеженого доступу до медичних закладів і забезпечує гнучкість у плануванні занять.

На завершення, стаття наголошує на необхідності подальших досліджень, у тому числі довготривалих, рандомізованих контрольованих випробувань, щоб вдосконалити підходи до метакогнітивної психотерапії й нейрогімнастики, визначити оптимальну «дозу» тренувань і проаналізувати їхню взаємодію з іншими компонентами відновлення. Такий системний підхід здатний суттєво покращити якість життя пацієнтів із пост-COVID синдромом, забезпечивши їм цілісний та науково обґрунтований шлях до одужання.

Ключові слова: пост-COVID синдром, нейрокогнітивні порушення, психічне здоров'я, метакогнітивна психотерапія, нейрогімнастика, телереабілітація, когнітивні функції, тривожність, депресія.

Problem statement. During the COVID-19 pandemic, a growing body of research has shifted attention from the acute phase of illness to longer-term sequelae collectively identified as post-COVID syndrome [9]. Affecting an estimated 10–30% of individuals recovering from SARS-CoV-2 infection, post-COVID syndrome is characterised by persistent symptoms lasting weeks or months beyond initial recovery (Hagiya et al., 2022). Among the most debilitating of these are neurocognitive impairments—encompassing memory lapses, difficulties in sustaining attention, and executive dysfunction—alongside psychiatric manifestations such as anxiety, depression, and post-traumatic stress disorder [7, 16].

A number of meta-analyses and observational studies have highlighted the prevalence of “brain fog” or subjective cognitive complaints, though objective assessments sometimes yield inconsistent findings [1, 8]. Regardless, even perceived deficits can significantly disrupt daily functioning, underscoring the need for comprehensive treatment approaches. The pathophysiology driving these

cognitive and emotional disturbances remains partially understood but is thought to involve immune dysregulation, neuroinflammation, vascular compromise, and psychosocial factors linked to pandemic-related stress [9, 16].

Given the multifaceted nature of post-COVID syndrome, non-pharmacological therapies have gained momentum as integral components of long-term care. Metacognitive psychotherapy, for instance, targets maladaptive thinking patterns (e.g., rumination, worry) through techniques that strengthen attentional control and enhance self-reflection [3, 7]. Concurrently, “neurogymnastics” approaches—rooted in cognitive training principles previously employed in older adult populations—aim to bolster neuroplasticity by engaging multiple neural circuits via structured exercises [4]. Early evidence indicates that pairing cognitive drills with physical or motor tasks can improve both brain function and psychological resilience.

Against this backdrop, the present article explores key neurocognitive markers of post-COVID syndrome, evaluates its mental health implications for adults, and proposes metacognitive psychotherapy and neurogymnastics as viable, complementary interventions. By integrating insights from neuroscience, clinical psychology, and rehabilitation research, the article aims to provide a holistic framework for identifying and addressing the cognitive and emotional consequences of this emergent chronic condition.

Analysis of recent studies and publications. The relevance of studying post-COVID syndrome, which encompasses both neurocognitive and psychological disorders, has been highlighted by researchers worldwide [5, 9, 16]. In particular, systematic reviews and meta-analyses emphasize the persistence or emergence of brain fog, attention and memory deficits, as well as anxiety, depression, and post-traumatic stress disorder (PTSD) in post-COVID patients. At the same time, other publications [1, 8] draw attention to the complexity of assessing ‘subjective’ versus ‘objective’ cognitive impairments: the absence of clear changes during neuropsychological testing does not necessarily rule out underlying or latent dysfunctions in patients.

Significant attention in current studies is devoted to identifying and implementing non-pharmacological approaches aimed at reducing the severity of these manifestations. Among such interventions, metacognitive psychotherapy [3] and neurogymnastics [4] stand out in particular. Metacognitive methods allow the correction of ineffective mental strategies (e.g., excessive worry or rumination), while neurogymnastics promotes enhanced neuroplasticity and improved executive functions through structured cognitive and motor exercises. However, despite their growing visibility in the scientific literature [11], questions regarding the systematization and optimal integration of these interventions into comprehensive rehabilitation programs for post-COVID patients remain insufficiently explored.

Purpose of the article. Drawing on an analysis of published research and clinical observations, the article seeks to comprehensively describe the

neurocognitive and psychiatric consequences of post-COVID syndrome in adults, and to substantiate the practical relevance and promise of metacognitive psychotherapy and neurogymnastics as complementary strategies for rehabilitation and restoration of cognitive health.

Presentation of the main material. Emerging research has identified several neurocognitive markers associated with post-COVID syndrome, providing critical insights into the underlying mechanisms of cognitive and mental health impairments. Neuroimaging studies have revealed structural and functional changes in the brain, including reduced grey matter volume in the prefrontal cortex and hippocampus, regions critical for memory, decision-making, and emotional regulation [2, 15]. These structural alterations are often accompanied by dysregulation of the default mode network (DMN), a brain network involved in self-referential thinking and cognitive flexibility. For instance, Rayhan and Baraniuk [10] demonstrated that individuals with post-exertional malaise, a common feature of post-COVID syndrome, exhibit increased activation of the anterior DMN node following physical exertion. This hyperactivation may contribute to cognitive dysfunction and symptom exacerbation, as the DMN is typically associated with rest and introspection rather than active task performance.

Cognitive assessments have further highlighted deficits in working memory, processing speed, and executive functioning, which are frequently reported by individuals with post-COVID syndrome [2]. These impairments are often accompanied by subjective reports of "brain fog," a term used to describe difficulties in concentration, mental clarity, and information processing. The interplay between these neurocognitive deficits and mental health challenges, such as anxiety and depression, creates a vicious cycle that exacerbates symptoms and impairs daily functioning [15]. For example, persistent fatigue, a hallmark of post-COVID syndrome, has been linked to both cognitive impairment and elevated levels of proinflammatory markers, suggesting a potential neuroinflammatory basis for these symptoms [2].

Recent studies have also emphasized the role of exercise-induced changes in brain activity as a potential biomarker for post-COVID syndrome. Rayhan and Baraniuk [10] found that submaximal exercise provokes increased activation of the anterior DMN in individuals with post-exertional malaise, a phenomenon not observed in healthy controls. This finding underscores the unique neurophysiological responses in post-COVID patients and highlights the need for tailored interventions that address both cognitive and physical symptoms.

Moreover, the relationship between neurocognitive impairments and systemic inflammation has been a focal point of research. Elevated levels of proinflammatory markers, such as C-reactive protein (CRP) and interleukin-6 (IL-6), have been observed in individuals with post-COVID syndrome, suggesting that chronic inflammation may contribute to both cognitive deficits and mental health challenges [2, 15]. These findings align with the broader literature on neuroinflammation and

its impact on brain function, providing a potential pathway for targeted therapeutic interventions.

Recent meta-analytic findings underscore that a distinct profile of persistent neurocognitive deficits frequently emerges in adults three or more months after acute COVID-19 infection [9]. Chief among these are memory impairments, attention dysregulation, and the colloquially termed “brain fog,” reflecting a generalised reduction in cognitive clarity and executive function. Alongside these symptoms, fatigue and sleep disturbances appear ubiquitous, suggesting that the neurocognitive domain is intertwined with post-infectious somatic factors. Intriguingly, hospitalisation during the acute phase may confer both protective and risk-enhancing effects: hospitalised patients displayed fewer reports of certain symptoms (e.g., anosmia, anxiety, depression), yet had a higher incidence of memory dysfunction compared with non-hospitalised individuals [9].

Notably, these neurocognitive markers do not exist in a vacuum; they evolve in tandem with psychiatric sequelae such as anxiety and depression, which appear to grow more prevalent over time. This dynamic emphasises a pressing need for robust, longitudinal frameworks that chart the evolution of neurocognitive and psychiatric statuses in post-COVID cohorts. Such frameworks would ideally include standardised clinical metrics to capture both subtle and overt cognitive changes, thereby guiding targeted interventions—such as metacognitive psychotherapy and neurogymnastic exercises—tailored to address the interplay of cognition, mood, and overall neurological health.

While the meta-analysis offers invaluable insights, subsequent commentary has drawn attention to data inconsistencies, notably in patient demographics and admission details [5]. Although these discrepancies warrant clarification, they do not diminish the broader conclusion that post-COVID syndromes are characterised by multifaceted neurological and neurocognitive disturbances. Moving forward, well-powered randomised controlled trials that measure and monitor these markers will be crucial to clarifying their pathophysiology and designing evidence-based interventions. The future of post-COVID care thus hinges on rigorous research that pinpoints cognitive vulnerability and leverages therapeutic innovation to bolster long-term neurocognitive resilience.

Adults with post-COVID syndrome face an elevated risk of mental health disorders, including anxiety and depression, due to both the chronic nature of their symptoms and the uncertainty surrounding recovery trajectories. Physiologically, the proinflammatory state induced by SARS-CoV-2 infection may disrupt neurotransmitter systems (e.g., serotonin and dopamine), heightening vulnerability to mood disturbances. Cognitively, post-COVID individuals often grapple with persistent brain fog, memory lapses, and concentration deficits—factors that can exacerbate psychological distress when they interfere with daily activities [16]. These deficits are not necessarily tied to obvious neuroimaging changes, underscoring the complexity of underlying mechanisms.

Moreover, post-traumatic stress disorder (PTSD) emerges as a prevalent concern, especially among individuals who endured severe illness or hospitalisation. The psychological impact of acute respiratory distress, coupled with prolonged social isolation, can precipitate long-lasting trauma responses. Critically, self-perceived cognitive deficits—commonly described as ‘brain fog’—may not always align with objective cognitive test results, yet still correlate strongly with heightened stress and fatigue [1]. This discrepancy highlights the importance of addressing subjective distress rather than relying solely on neuropsychological assessments.

In line with these findings, growing evidence suggests that cognitive impairment and psychiatric sequelae can persist for months or even years [8]. Risk factors such as age, pre-existing comorbidities, and the severity of the acute infection amplify the likelihood of chronic mental health issues. Consequently, a comprehensive approach to post-COVID care—one that integrates psychological interventions, cognitive rehabilitation, and ongoing psychosocial support—appears vital. By recognising that both objective deficits and subjective experiences shape mental well-being, practitioners can tailor interventions, such as metacognitive psychotherapy, to bolster coping mechanisms while addressing emotional and cognitive challenges in tandem.

Metacognitive psychotherapy, grounded in the principles of metacognitive theory, provides a structured framework for addressing the intertwined cognitive and emotional challenges of post-COVID syndrome. Central to this approach is the targeting of maladaptive cognitive processes—especially worry, rumination, and thought suppression—that perpetuate distress and hinder recovery [7]. By helping individuals recognise and regulate these internal thought patterns, metacognitive interventions reduce cognitive load and foster more flexible, adaptive responses to stress.

A central pillar of metacognitive psychotherapy is metacognitive awareness: the ability to reflect on one’s own thinking. Through guided exercises, patients learn to distinguish ruminative thought processes from productive problem-solving. In tandem, detached mindfulness techniques teach individuals to observe their thoughts and emotions without becoming engulfed by them. Another key tool, Attention Training (ATT), strengthens the capacity to shift and sustain focus, addressing the attentional difficulties often reported in post-COVID syndrome.

A growing body of research underscores the effectiveness of metacognitive interventions in mitigating psychological distress. For instance, Analytical Metacognitive Therapy (AMT) has been shown to reduce anxiety and depression among nurses in COVID-19 wards [11]. By interrupting negative thought cycles and enhancing “ego strength,” AMT fosters resilience in demanding clinical environments—lessons that can readily translate to individuals suffering persistent post-COVID symptoms. Meanwhile, Metacognitive Reflection and Insight Therapy (MERIT), originally designed for individuals with psychosis, has been successfully adapted for virtual delivery [3]. MERIT’s collaborative, insight-oriented approach

could prove particularly helpful for post-COVID patients grappling with cognitive fog and the resultant disruptions to daily functioning.

Cognitive overload and psychological distress frequently go hand-in-hand among post-COVID patients. Metacognitive psychotherapy directly tackles these obstacles by targeting worry and rumination, processes that often underlie both emotional turmoil and exacerbated cognitive impairment [7]. Crucially, by helping individuals alter how they engage with their own thoughts, metacognitive strategies may also foster beneficial neuroplastic changes, supporting the brain's capacity to adapt even in the face of lingering COVID-related inflammation or other neurological sequelae.

The pandemic has underscored telehealth's potential as a practical treatment platform, and metacognitive therapy modalities have proven readily adaptable to virtual formats [3]. Online sessions allow practitioners to integrate interactive mindfulness exercises or digital tools that reinforce metacognitive reflection and attention control. This flexibility is vital given the fluctuating symptom burden many post-COVID patients experience, ensuring they can access consistent support regardless of location or health status.

More large-scale research is needed to determine how metacognitive interventions can be optimally integrated into standard post-COVID care. Such studies might involve neuroimaging and cognitive testing to gauge how these therapies affect both subjective distress and objective cognitive metrics. Additionally, training more healthcare providers in metacognitive techniques could foster an interdisciplinary approach, weaving together psychotherapy, neurorehabilitation, and other supportive measures to address the full spectrum of post-COVID challenges.

Ultimately, metacognitive psychotherapy offers a promising route for individuals struggling with the persistent cognitive and emotional sequelae of COVID-19. By equipping patients to identify and modify unhelpful thought patterns, this therapeutic model tackles a core driver of post-COVID distress—paving the way for clearer cognition, improved emotional well-being, and more durable recovery outcomes.

Neurogymnastics—an umbrella term for cognitive training exercises that integrate structured activities such as dual-task drills, memory games, and problem-solving—has garnered attention as a non-pharmacological tool for countering cognitive impairments. Traditional cognitive exercise interventions have demonstrated benefits in older adults by enhancing cognitive reserve and reducing the risk of dementia [4]. Drawing on these principles, neurogymnastics can be adapted for post-COVID rehabilitation, where deficits in memory, attention, and executive functioning are frequently reported.

Designing effective neurogymnastics programs involves tailoring exercise intensity, complexity, and duration to individual capabilities and recovery stages. Although most current data derive from studies in older adults and patient

populations with established neurological conditions [4], the core principle—intense, targeted stimulation of neural circuits—can reasonably extend to post-COVID rehabilitation.

In sum, neurogymnastics offers a structured, multifaceted strategy to support cognitive healing in post-COVID syndrome. By engaging multiple brain regions and fostering neuroplasticity, it may help rebuild disrupted neural networks and bolster both cognitive and functional resilience.

Conclusion. In synthesising the current evidence on post-COVID syndrome, persistent neurocognitive deficits—including memory impairment, concentration difficulties, and executive dysfunction—often intersect with significant mental health challenges such as anxiety, depression, and PTSD. These interconnected problems can substantially diminish quality of life and undermine long-term recovery. Metacognitive psychotherapy and neurogymnastics emerge as compelling, non-pharmacological strategies that address both cognitive and emotional dimensions of post-COVID sequelae. By targeting maladaptive thought processes and facilitating neuroplasticity through structured cognitive and motor tasks, these interventions promise a holistic approach to rehabilitation. Nevertheless, further research—particularly large-scale, longitudinal studies—is required to refine implementation protocols, establish efficacy across diverse patient groups, and explore potential synergies between metacognitive and neurorehabilitative therapies. Ultimately, an integrated model of care that incorporates metacognitive psychotherapy, neurogymnastics, and other supportive services holds the potential to enhance functional outcomes, improve quality of life, and foster more resilient recoveries for individuals affected by post-COVID syndrome.

References:

1. Bland, A. R., Barraclough, M., Trender, W. R., Mehta, M. A., Hellyer, P. J., Hampshire, A., Penner, I. K., Elliott, R., & Harenwall, S. (2024). Profiles of objective and subjective cognitive function in Post-COVID Syndrome, COVID-19 recovered, and COVID-19 naïve individuals. *Scientific Reports*, 14(1), 13368. <https://doi.org/10.1038/s41598-024-62050-x>
2. Ceban, F., Ling, S., Lui, L. M. W., Lee, Y., Gill, H., Teopiz, K. M., ... & McIntyre, R. S. (2022). Fatigue and cognitive impairment in Post-COVID-19 Syndrome: A systematic review and meta-analysis. *Brain, Behavior, and Immunity*, 101, 93–135. <https://doi.org/10.1016/j.bbi.2021.12.020>
3. Faith, L. A., Zou, D. S., & Kukla, M. (2023). Metacognitive Reflection and Insight Therapy (MERIT) delivered virtually during the COVID-19 pandemic: An illustration of two cases. *Journal of Contemporary Psychotherapy*, 53(1), 71–79.
4. Gates, N. J., & Valenzuela, M. (2010). Cognitive exercise and its role in cognitive function in older adults. *Current Psychiatry Reports*, 12(1), 20-27.
5. Hagiya, H., Otsuka, Y., & Otsuka, F. (2022). Call for correction: Mid and long-term neurological and neuropsychiatric manifestations of post-COVID-19 syndrome: A meta-analysis. *Journal of the Neurological Sciences*, 436, 120232. <https://doi.org/10.1016/j.jns.2022.120232>
6. Hampshire, A., et al. (2021). Cognitive deficits in people who have recovered from COVID-19. *The Lancet Psychiatry*, 8(5), 416-427.
7. Hoffart, A., Johnson, S. U., & Ebrahimi, O. V. (2022). Metacognitive beliefs, maladaptive coping strategies, and depressive symptoms: A two-wave network study of the COVID-19 lockdown and reopening. *Journal of Psychiatric Research*, 152, 70–78.

8. Julide, T., Cigdem, T., & Baris, T. (2024). Cognitive impairment in long-COVID. *Ideggyogyaszati Szemle*, 77(5-6), 151–159. <https://doi.org/10.18071/isz.77.0151>
9. Premraj, L., Kannapadi, N. V., Briggs, J., Seal, S. M., Battaglini, D., Fanning, J., Suen, J., Robba, C., Fraser, J., & Cho, S. M. (2022). Mid and long-term neurological and neuropsychiatric manifestations of post-COVID-19 syndrome: A meta-analysis. *Journal of the Neurological Sciences*, 434, 120162. <https://doi.org/10.1016/j.jns.2022.120162>
10. Rayhan, R. U., & Baraniuk, J. N. (2021). Submaximal exercise provokes increased activation of the anterior default mode network during the resting state as a biomarker of postexertional malaise in myalgic encephalomyelitis/chronic fatigue syndrome. *Frontiers in Neuroscience*, 15, 748426. <https://doi.org/10.3389/fnins.2021.748426>
11. Shahbakhsh, R., Soleimani, A., Kachooei, M., & Farahani, H. (2024). The Effect of Analytical Metacognitive Therapy on Reducing Residual Anxiety and Depression of Nurses in Covid-19 Wards. *International Journal of Behavioral Sciences*, 18(3), 149–157.
12. Sick, J., & König, D. (2023). Exercise training in non-hospitalized patients with post-COVID-19 syndrome—A narrative review. *Healthcare*, 11(16), 2277. <https://doi.org/10.3390/healthcare11162277>
13. Valkanova, V., Ebmeier, K. P., & Allan, C. L. (2013). CRP, IL-6 and depression: a systematic review and meta-analysis of longitudinal studies. *Journal of affective disorders*, 150(3), 736–744. <https://doi.org/10.1016/j.jad.2013.06.004>
14. Wells, A. (2009). *Metacognitive Therapy for Anxiety and Depression*. Guilford Press.
15. Yong, S. J. (2021). Long COVID or post-COVID-19 syndrome: putative pathophysiology, risk factors, and treatments. *Infectious Diseases*, 53(10), 737–754. <https://doi.org/10.1080/23744235.2021.1924397>
16. Zhao, S., Toniolo, S., Hampshire, A., & Husain, M. (2023). Effects of COVID-19 on cognition and brain health. *Trends in Cognitive Sciences*, 27(11), 1053–1067. <https://doi.org/10.1016/j.tics.2023.08.008>

Література:

1. Bland, A. R., Barraclough, M., Trender, W. R., Mehta, M. A., Hellyer, P. J., Hampshire, A., Penner, I. K., Elliott, R., & Harenwall, S. (2024). Profiles of objective and subjective cognitive function in Post-COVID Syndrome, COVID-19 recovered, and COVID-19 naïve individuals. *Scientific Reports*, 14(1), 13368. <https://doi.org/10.1038/s41598-024-62050-x>
2. Ceban, F., Ling, S., Lui, L. M. W., Lee, Y., Gill, H., Teopiz, K. M., ... & McIntyre, R. S. (2022). Fatigue and cognitive impairment in Post-COVID-19 Syndrome: A systematic review and meta-analysis. *Brain, Behavior, and Immunity*, 101, 93–135. <https://doi.org/10.1016/j.bbi.2021.12.020>
3. Faith, L. A., Zou, D. S., & Kukla, M. (2023). Metacognitive Reflection and Insight Therapy (MERIT) delivered virtually during the COVID-19 pandemic: An illustration of two cases. *Journal of Contemporary Psychotherapy*, 53(1), 71–79.
4. Gates, N. J., & Valenzuela, M. (2010). Cognitive exercise and its role in cognitive function in older adults. *Current Psychiatry Reports*, 12(1), 20–27.
5. Hagiya, H., Otsuka, Y., & Otsuka, F. (2022). Call for correction: Mid and long-term neurological and neuropsychiatric manifestations of post-COVID-19 syndrome: A meta-analysis. *Journal of the Neurological Sciences*, 436, 120232. <https://doi.org/10.1016/j.jns.2022.120232>
6. Hampshire, A., et al. (2021). Cognitive deficits in people who have recovered from COVID-19. *The Lancet Psychiatry*, 8(5), 416–427.
7. Hoffart, A., Johnson, S. U., & Ebrahimi, O. V. (2022). Metacognitive beliefs, maladaptive coping strategies, and depressive symptoms: A two-wave network study of the COVID-19 lockdown and reopening. *Journal of Psychiatric Research*, 152, 70–78.

8. Julide, T., Cigdem, T., & Baris, T. (2024). Cognitive impairment in long-COVID. *Ideggogyaszati Szemle*, 77(5-6), 151–159. <https://doi.org/10.18071/isz.77.0151>
9. Premraj, L., Kannapadi, N. V., Briggs, J., Seal, S. M., Battaglini, D., Fanning, J., Suen, J., Robba, C., Fraser, J., & Cho, S. M. (2022). Mid and long-term neurological and neuropsychiatric manifestations of post-COVID-19 syndrome: A meta-analysis. *Journal of the Neurological Sciences*, 434, 120162. <https://doi.org/10.1016/j.jns.2022.120162>
10. Rayhan, R. U., & Baraniuk, J. N. (2021). Submaximal exercise provokes increased activation of the anterior default mode network during the resting state as a biomarker of postexertional malaise in myalgic encephalomyelitis/chronic fatigue syndrome. *Frontiers in Neuroscience*, 15, 748426. <https://doi.org/10.3389/fnins.2021.748426>
11. Shahbakhsh, R., Soleimani, A., Kachooei, M., & Farahani, H. (2024). The Effect of Analytical Metacognitive Therapy on Reducing Residual Anxiety and Depression of Nurses in Covid-19 Wards. *International Journal of Behavioral Sciences*, 18(3), 149–157.
12. Sick, J., & König, D. (2023). Exercise training in non-hospitalized patients with post-COVID-19 syndrome—A narrative review. *Healthcare*, 11(16), 2277. <https://doi.org/10.3390/healthcare11162277>
13. Valkanova, V., Ebmeier, K. P., & Allan, C. L. (2013). CRP, IL-6 and depression: a systematic review and meta-analysis of longitudinal studies. *Journal of affective disorders*, 150(3), 736–744. <https://doi.org/10.1016/j.jad.2013.06.004>
14. Wells, A. (2009). *Metacognitive Therapy for Anxiety and Depression*. Guilford Press.
15. Yong, S. J. (2021). Long COVID or post-COVID-19 syndrome: putative pathophysiology, risk factors, and treatments. *Infectious Diseases*, 53(10), 737–754. <https://doi.org/10.1080/23744235.2021.1924397>
16. Zhao, S., Toniolo, S., Hampshire, A., & Husain, M. (2023). Effects of COVID-19 on cognition and brain health. *Trends in Cognitive Sciences*, 27(11), 1053–1067. <https://doi.org/10.1016/j.tics.2023.08.008>