

Unraveling Long COVID Care: Clinical Advances and Future Directions

Management of Smell and Taste Loss Post-COVID

Zara Marzban Patel, MD

- Blomqvist, E. H., Lundblad, L., Bergstedt, H., & Stjärne, P. (2003). Placebo-controlled, randomized, double-blind study evaluating the efficacy of fluticasone propionate nasal spray for the treatment of patients with hyposmia/anosmia. *Acta oto-laryngologica*, 123(7), 862–868. <https://doi.org/10.1080/00016480310002140>
- de Melo, G. D., Lazarini, F., Levallois, S., Hautefort, C., Michel, V., Larrous, F., Verillaud, B., Aparicio, C., Wagner, S., Gheusi, G., Kergoat, L., Kornobis, E., Donati, F., Cokelaer, T., Hervochon, R., Madec, Y., Roze, E., Salmon, D., Bourhy, H., Lecuit, M., ... Lledo, P. M. (2021). COVID-19-related anosmia is associated with viral persistence and inflammation in human olfactory epithelium and brain infection in hamsters. *Science translational medicine*, 13(596), eabf8396. <https://doi.org/10.1126/scitranslmed.abf8396>
- Devanand, D. P., Lee, S., Manly, J., Andrews, H., Schupf, N., Masurkar, A., Stern, Y., Mayeux, R., & Doty, R. L. (2015). Olfactory identification deficits and increased mortality in the community. *Annals of neurology*, 78(3), 401–411. <https://doi.org/10.1002/ana.24447>
- Fieux, M., Castro, B. R., Jang, S. S., Yan, C. H., & Patel, Z. M. (2025). Long-term Outcomes of PRP Injections for Post-viral Olfactory Loss: A Prospective Cohort Study. *International forum of allergy & rhinology*, 15(4), 420–427. <https://doi.org/10.1002/alr.23505>
- Knecht, M., & Hummel, T. (2004). Recording of the human electro-olfactogram. *Physiology & behavior*, 83(1), 13–19. <https://doi.org/10.1016/j.physbeh.2004.07.024>
- Kollndorfer, K., Kowalczyk, K., Hoche, E., Mueller, C. A., Pollak, M., Trattinig, S., & Schöpf, V. (2014). Recovery of olfactory function induces neuroplasticity effects in patients with smell loss. *Neural plasticity*, 2014, 140419. <https://doi.org/10.1155/2014/140419>
- Nguyen, T. P., & Patel, Z. M. (2018). Budesonide irrigation with olfactory training improves outcomes compared with olfactory training alone in patients with olfactory loss. *International forum of allergy & rhinology*, 8(9), 977–981. <https://doi.org/10.1002/alr.22140>
- Patel, Z. M., Holbrook, E. H., Turner, J. H., Adappa, N. D., Albers, M. W., Altundag, A., Appenzeller, S., Costanzo, R. M., Croy, I., Davis, G. E., Dehgani-Mobaraki, P., Doty, R. L., Duffy, V. B., Goldstein, B. J., Gudis, D. A., Haehner, A., Higgins, T. S., Hopkins, C.,

- Huart, C., Hummel, T., ... Yan, C. H. (2022). International consensus statement on allergy and rhinology: Olfaction. *International forum of allergy & rhinology*, 12(4), 327–680. <https://doi.org/10.1002/alr.22929>
- Patel, Z. M., Wise, S. K., & DelGaudio, J. M. (2017). Randomized Controlled Trial Demonstrating Cost-Effective Method of Olfactory Training in Clinical Practice: Essential Oils at Uncontrolled Concentration. *Laryngoscope investigative otolaryngology*, 2(2), 53–56. <https://doi.org/10.1002/lio2.62>
- Stein, S. R., Ramelli, S. C., Grazioli, A., Chung, J. Y., Singh, M., Yinda, C. K., Winkler, C. W., Sun, J., Dickey, J. M., Ylaya, K., Ko, S. H., Platt, A. P., Burbelo, P. D., Quezado, M., Pittaluga, S., Purcell, M., Munster, V. J., Belinky, F., Ramos-Benitez, M. J., Boritz, E. A., ... Chertow, D. S. (2022). SARS-CoV-2 infection and persistence in the human body and brain at autopsy. *Nature*, 612(7941), 758–763. <https://doi.org/10.1038/s41586-022-05542-y>
- Yan, C. H., Overdevest, J. B., & Patel, Z. M. (2019). Therapeutic use of steroids in non-chronic rhinosinusitis olfactory dysfunction: a systematic evidence-based review with recommendations. *International forum of allergy & rhinology*, 9(2), 165–176. <https://doi.org/10.1002/alr.22240>
- Yan, C. H., Jang, S. S., Lin, H. C., Ma, Y., Khanwalkar, A. R., Thai, A., & Patel, Z. M. (2023). Use of platelet-rich plasma for COVID-19-related olfactory loss: a randomized controlled trial. *International forum of allergy & rhinology*, 13(6), 989–997. <https://doi.org/10.1002/alr.23116>
- Yan, C. H., Rathor, A., Krook, K., Ma, Y., Rotella, M. R., Dodd, R. L., Hwang, P. H., Nayak, J. V., Oyesiku, N. M., DelGaudio, J. M., Levy, J. M., Wise, J., Wise, S. K., & Patel, Z. M. (2020). Effect of Omega-3 Supplementation in Patients With Smell Dysfunction Following Endoscopic Sellar and Parasellar Tumor Resection: A Multicenter Prospective Randomized Controlled Trial. *Neurosurgery*, 87(2), E91–E98. <https://doi.org/10.1093/neuros/nyz559>

Care for Headache Types in Long COVID

Leon S Moskatel, MD

- Chhabra, N., Grill, M. F., & Singh, R. B. H. (2022). Post-COVID Headache: A Literature Review. *Current pain and headache reports*, 26(11), 835–842. <https://doi.org/10.1007/s11916-022-01086-y>

Choi S, Hong Y, Kang MK, Song TJ, Cho SJ. (2025). Calcitonin Gene-Related Peptide Monoclonal Antibody Treatment in Nine Cases of Persistent Headache Following COVID-19-Infection. *J Korean Med Sci.* 40:e127.
<https://doi.org/10.3346/jkms.2025.40.e127>

Gonzalez-Martinez, A., Guerrero-Peral, Á. L., Arias-Rivas, S., Silva, L., Sierra, Á., Gago-Veiga, A. B., & García-Azorín, D. (2022). Amitriptyline for post-COVID headache: effectiveness, tolerability, and response predictors. *Journal of neurology*, 269(11), 5702–5709. <https://doi.org/10.1007/s00415-022-11225-5>

Gastrointestinal Issues Post-COVID and Their Management

John Mark Mark Gubatan, MD

Blackett, J. W., Gautam, M., Mishra, R., Oblizajek, N. R., Kathavarayan Ramu, S., Bailey, K. R., & Bharucha, A. E. (2022). Comparison of Anorectal Manometry, Rectal Balloon Expulsion Test, and Defecography for Diagnosing Defecatory Disorders. *Gastroenterology*, 163(6), 1582–1592.e2. <https://doi.org/10.1053/j.gastro.2022.08.034>

Camilleri, M., Kuo, B., Nguyen, L., Vaughn, V. M., Petrey, J., Greer, K., Yadlapati, R., & Abell, T. L. (2022). ACG Clinical Guideline: Gastroparesis. *The American journal of gastroenterology*, 117(8), 1197–1220. <https://doi.org/10.14309/ajg.0000000000001874>

Cheung, K. S., Hung, I. F. N., Chan, P. P. Y., Lung, K. C., Tso, E., Liu, R., Ng, Y. Y., Chu, M. Y., Chung, T. W. H., Tam, A. R., Yip, C. C. Y., Leung, K. H., Fung, A. Y., Zhang, R. R., Lin, Y., Cheng, H. M., Zhang, A. J. X., To, K. K. W., Chan, K. H., Yuen, K. Y., ... Leung, W. K. (2020). Gastrointestinal Manifestations of SARS-CoV-2 Infection and Virus Load in Fecal Samples From a Hong Kong Cohort: Systematic Review and Meta-analysis. *Gastroenterology*, 159(1), 81–95. <https://doi.org/10.1053/j.gastro.2020.03.065>

Drossman, D. A., & Hasler, W. L. (2016). Rome IV-Functional GI Disorders: Disorders of Gut-Brain Interaction. *Gastroenterology*, 150(6), 1257–1261.
<https://doi.org/10.1053/j.gastro.2016.03.035>

Ford, A. C., Mahadeva, S., Carbone, M. F., Lacy, B. E., & Talley, N. J. (2020). Functional dyspepsia. *Lancet (London, England)*, 396(10263), 1689–1702.
[https://doi.org/10.1016/S0140-6736\(20\)30469-4](https://doi.org/10.1016/S0140-6736(20)30469-4)

Ford, A. C., Moayyedi, P., Black, C. J., Yuan, Y., Veettil, S. K., Mahadeva, S., Kengkla, K., Chaiyakunapruk, N., & Lee, Y. Y. (2021). Systematic review and network meta-analysis:

- efficacy of drugs for functional dyspepsia. *Alimentary pharmacology & therapeutics*, 53(1), 8–21. <https://doi.org/10.1111/apt.16072>
- Golla, R., Vuyyuru, S., Kante, B., Kumar, P., Thomas, D. M., Makharia, G., Kedia, S., & Ahuja, V. (2023). Long-term Gastrointestinal Sequelae Following COVID-19: A Prospective Follow-up Cohort Study. *Clinical gastroenterology and hepatology : the official clinical practice journal of the American Gastroenterological Association*, 21(3), 789–796.e1. <https://doi.org/10.1016/j.cgh.2022.10.015>
- Gyawali, C. P., & Fass, R. (2018). Management of Gastroesophageal Reflux Disease. *Gastroenterology*, 154(2), 302–318. <https://doi.org/10.1053/j.gastro.2017.07.049>
- Gyawali, C. P., Yadlapati, R., Fass, R., Katzka, D., Pandolfino, J., Savarino, E., Sifrim, D., Spechler, S., Zerbib, F., Fox, M. R., Bhatia, S., de Bortoli, N., Cho, Y. K., Cisternas, D., Chen, C. L., Cock, C., Hani, A., Remes Troche, J. M., Xiao, Y., Vaezi, M. F., ... Roman, S. (2024). Updates to the modern diagnosis of GERD: Lyon consensus 2.0. *Gut*, 73(2), 361–371. <https://doi.org/10.1136/gutjnl-2023-330616>
- Holtmann, G. J., Ford, A. C., & Talley, N. J. (2016). Pathophysiology of irritable bowel syndrome. *The lancet. Gastroenterology & hepatology*, 1(2), 133–146. [https://doi.org/10.1016/S2468-1253\(16\)30023-1](https://doi.org/10.1016/S2468-1253(16)30023-1)
- Johannesson, E., Simrén, M., Strid, H., Bajor, A., & Sadik, R. (2011). Physical activity improves symptoms in irritable bowel syndrome: a randomized controlled trial. *The American journal of gastroenterology*, 106(5), 915–922. <https://doi.org/10.1038/ajg.2010.480>
- Katzka, D. A., Pandolfino, J. E., & Kahrilas, P. J. (2020). Phenotypes of Gastroesophageal Reflux Disease: Where Rome, Lyon, and Montreal Meet. *Clinical gastroenterology and hepatology : the official clinical practice journal of the American Gastroenterological Association*, 18(4), 767–776. <https://doi.org/10.1016/j.cgh.2019.07.015>
- Lembo, A., Sultan, S., Chang, L., Heidelbaugh, J. J., Smalley, W., & Verne, G. N. (2022). AGA Clinical Practice Guideline on the Pharmacological Management of Irritable Bowel Syndrome With Diarrhea. *Gastroenterology*, 163(1), 137–151. <https://doi.org/10.1053/j.gastro.2022.04.017>
- Naliboff, B. D., Smith, S. R., Serpa, J. G., Laird, K. T., Stains, J., Connolly, L. S., Labus, J. S., & Tillisch, K. (2020). Mindfulness-based stress reduction improves irritable bowel syndrome (IBS) symptoms via specific aspects of mindfulness. *Neurogastroenterology and motility*, 32(9), e13828. <https://doi.org/10.1111/nmo.13828>

Parasa, S., Desai, M., Thoguluva Chandrasekar, V., Patel, H. K., Kennedy, K. F., Roesch, T., Spadaccini, M., Colombo, M., Gabbiadini, R., Artifon, E. L. A., Repici, A., & Sharma, P. (2020). Prevalence of Gastrointestinal Symptoms and Fecal Viral Shedding in Patients With Coronavirus Disease 2019: A Systematic Review and Meta-analysis. *JAMA network open*, 3(6), e2011335. <https://doi.org/10.1001/jamanetworkopen.2020.11335>

Tack, J., Janssen, P., Masaoka, T., Farré, R., & Van Oudenhove, L. (2012). Efficacy of buspirone, a fundus-relaxing drug, in patients with functional dyspepsia. *Clinical gastroenterology and hepatology : the official clinical practice journal of the American Gastroenterological Association*, 10(11), 1239–1245. <https://doi.org/10.1016/j.cgh.2012.06.036>

Tenner, S., Vege, S. S., Sheth, S. G., Sauer, B., Yang, A., Conwell, D. L., Yadlapati, R. H., & Gardner, T. B. (2024). American College of Gastroenterology Guidelines: Management of Acute Pancreatitis. *The American journal of gastroenterology*, 119(3), 419–437. <https://doi.org/10.14309/ajg.0000000000002645>

Coagulation and Other Hematologic Considerations in Long COVID

Beth A. Martin, MD

Cines, D. B., Lebedeva, T., Nagaswami, C., Hayes, V., Masefski, W., Litvinov, R. I., Rauova, L., Lowery, T. J., & Weisel, J. W. (2014). Clot contraction: compression of erythrocytes into tightly packed polyhedra and redistribution of platelets and fibrin. *Blood*, 123(10), 1596–1603. <https://doi.org/10.1182/blood-2013-08-523860>

Nicolai, L., Kaiser, R., & Stark, K. (2023). Thromboinflammation in long COVID-the elusive key to postinfection sequelae?. *Journal of thrombosis and haemostasis : JTH*, 21(8), 2020–2031. <https://doi.org/10.1016/j.jtha.2023.04.039>

Eslamifar, Z., Behzadifard, M., & Zare, E. (2025). Investigation of homocysteine, D-dimer and platelet count levels as potential predictors of thrombosis risk in COVID-19 patients. *Molecular and cellular biochemistry*, 480(1), 439–444. <https://doi.org/10.1007/s11010-024-04967-5>

Yucan Li, Zhengqi Jiang, Fengjiao Han, Qiuyu Guo, Qi Feng, Tichao Shan, Jun Peng, Miao Xu. (2024). Coagulation Abnormalities in Post-Acute COVID-19 Syndrome: A Cross-Sectional Study. *Blood*; 144 (Supplement 1): 1232. doi: <https://doi.org/10.1182/blood-2024-207215>

- Conrad, C., Magnen, M., Tsui, J., Wismer, H., Naser, M., Venkataramani, U., Samad, B., Cleary, S. J., Qiu, L., Tian, J. J., De Giovanni, M., Mende, N., Passegue, E., Laurenti, E., Combes, A. J., & Looney, M. R. (2024). Decoding functional hematopoietic progenitor cells in the adult human lung. *Research square*, rs.3.rs-3576483. <https://doi.org/10.21203/rs.3.rs-3576483/v2>
- Shafqat, A., Omer, M. H., Albalkhi, I., Alabdul Razzak, G., Abdulkader, H., Abdul Rab, S., Sabbah, B. N., Alkattan, K., & Yaqinuddin, A. (2023). Neutrophil extracellular traps and long COVID. *Frontiers in immunology*, 14, 1254310. <https://doi-org.laneproxy.stanford.edu/10.3389/fimmu.2023.1254310>
- Monsalve, D. M., Acosta-Ampudia, Y., Acosta, N. G., Celis-Andrade, M., Şahin, A., Yilmaz, A. M., Shoenfeld, Y., & Ramírez-Santana, C. (2025). NETosis: A key player in autoimmunity, COVID-19, and long COVID. *Journal of translational autoimmunity*, 10, 100280. <https://doi-org.laneproxy.stanford.edu/10.1016/j.jtauto.2025.100280>
- Michal Santocki, Anna Such, Dominika Drab, Gabriela Burczyk, Elzbieta Kolaczowska. (2025). NETs persisting in vasculature undergo self-renewal with consequences for subsequent infection: a mouse model study. *Blood*; 145 (18): 2070–2085. doi: <https://doi.org/10.1182/blood.2024026643>
- Sabaghian, T., Kharazmi, A. B., Omid, F., Hajikhani, B., Tehrani, S., Mardani, S., Shahidi Bonjar, A. H., Centis, R., D'Ambrosio, L., Sotgiu, G., Fabio, A., Nasiri, M. J., & Migliori, G. B. (2025). Antiphospholipid Antibodies and COVID-19: A Systematic Review of Clinical Implications. *Immunity, inflammation and disease*, 13(2), e70134. <https://doi.org/10.1002/iid3.70134>
- Ware, A. D., Veigulis, Z. P., Hoover, P. J., Blumke, T. L., Ioannou, G. N., Boyko, E. J., & Osborne, T. F. (2024). Incidence and risk of post-COVID-19 thromboembolic disease and the impact of aspirin prescription; nationwide observational cohort at the US Department of Veteran Affairs. *PloS one*, 19(9), e0302612. <https://doi.org/10.1371/journal.pone.0302612>
- Jara-Palomares, L., Bikdeli, B., Jiménez, D., Muriel, A., Demelo-Rodríguez, P., Moustafa, F., Villalobos, A., López-Miguel, P., López-Jiménez, L., Otálora, S., Peris, M. L., Amado, C., Chopard, R., Rivera-Cívico, F., Monreal, M., & RIETE Investigators (2024). Risk of recurrence after discontinuing anticoagulation in patients with COVID-19- associated venous thromboembolism: a prospective multicentre cohort study. *EClinicalMedicine*, 73, 102659. <https://doi.org/10.1016/j.eclinm.2024.102659>

Behavioral Health Management in Long COVID

Tyler Prestwood, MD, PhD

Marchi, M., Grenzi, P., Serafini, V., Capoccia, F., Rossi, F., Marrino, P., Pingani, L., Galeazzi, G. M., & Ferrari, S. (2023). Psychiatric symptoms in Long-COVID patients: a systematic review. *Frontiers in psychiatry*, *14*, 1138389. <https://doi.org/10.3389/fpsyt.2023.1138389>

Lai, Y. J., Liu, S. H., Manachevakul, S., Lee, T. A., Kuo, C. T., & Bello, D. (2023). Biomarkers in long COVID-19: A systematic review. *Frontiers in medicine*, *10*, 1085988. <https://doi.org/10.3389/fmed.2023.1085988>

Low, R. N., Low, R. J., & Akrami, A. (2023). A review of cytokine-based pathophysiology of Long COVID symptoms. *Frontiers in medicine*, *10*, 1011936. <https://doi.org/10.3389/fmed.2023.1011936>

Cui, L., Li, S., Wang, S., Wu, X., Liu, Y., Yu, W., Wang, Y., Tang, Y., Xia, M., & Li, B. (2024). Major depressive disorder: hypothesis, mechanism, prevention and treatment. *Signal transduction and targeted therapy*, *9*(1), 30. <https://doi.org/10.1038/s41392-024-01738-y>

Shaw, B. H., Stiles, L. E., Bourne, K., Green, E. A., Shibao, C. A., Okamoto, L. E., Garland, E. M., Gamboa, A., Diedrich, A., Raj, V., Sheldon, R. S., Biaggioni, I., Robertson, D., & Raj, S. R. (2019). The face of postural tachycardia syndrome - insights from a large cross-sectional online community-based survey. *Journal of internal medicine*, *286*(4), 438–448. <https://doi.org/10.1111/joim.12895>

Rus, C. P., de Vries, B. E. K., de Vries, I. E. J., Nutma, I., & Kooij, J. J. S. (2023). Treatment of 95 post-Covid patients with SSRIs. *Scientific reports*, *13*(1), 18599. <https://doi.org/10.1038/s41598-023-45072-9>

Prasanth, M.I., Wannigama, D.L., Reiersen, A.M. *et al.* (2024). A systematic review and meta-analysis, investigating dose and time of fluvoxamine treatment efficacy for COVID-19 clinical deterioration, death, and Long-COVID complications. *Sci Rep* *14*, 13462. <https://doi.org/10.1038/s41598-024-64260-9>

Coping with the Psychological Impact of Long COVID

Shelby Lazarow, PsyD

Kubota, T., Kuroda, N., & Sone, D. (2023). Neuropsychiatric aspects of long COVID: A comprehensive review. *Psychiatry and clinical neurosciences*, *77*(2), 84–93. <https://doi.org/10.1111/pcn.13508>

- Julide, T., Cigdem, T., & Baris, T. (2024). Cognitive impairment in long-COVID. Kognitív károsodás hosszú Covid esetén. *Ideggyógyászati szemle*, 77(5-6), 151–159. <https://doi.org/10.18071/isz.77.0151>
- Gardi, C., Fazia, T., Stringa, B., & Giommi, F. (2022). A short Mindfulness retreat can improve biological markers of stress and inflammation. *Psychoneuroendocrinology*, 135, 105579. <https://doi.org/10.1016/j.psyneuen.2021.105579>
- Rodriguez-Ayllon, M., Cadenas-Sánchez, C., Estévez-López, F., Muñoz, N. E., Mora-Gonzalez, J., Migueles, J. H., Molina-García, P., Henriksson, H., Mena-Molina, A., Martínez-Vizcaíno, V., Catena, A., Löf, M., Erickson, K. I., Lubans, D. R., Ortega, F. B., & Esteban-Cornejo, I. (2019). Role of Physical Activity and Sedentary Behavior in the Mental Health of Preschoolers, Children and Adolescents: A Systematic Review and Meta-Analysis. *Sports medicine (Auckland, N.Z.)*, 49(9), 1383–1410. <https://doi.org/10.1007/s40279-019-01099-5>
- Househam A. M. (2023). Effects of stress and mindfulness on epigenetics. *Vitamins and hormones*, 122, 283–306. <https://doi.org/10.1016/bs.vh.2022.11.003>
- Schutte, N. S., & Malouff, J. M. (2016). General and realm-specific self-efficacy: Connections to life functioning. *Current Psychology: A Journal for Diverse Perspectives on Diverse Psychological Issues*, 35(3), 361–369. <https://doi.org/10.1007/s12144-014-9301-y>
- Goodman, R. S., Lawless, A., Woodford, R., Fa'ak, F., Tipirneni, A., Patrinely, J. R., Yeoh, H. L., Rapisuwon, S., Haydon, A., Osman, I., Mehnert, J. M., Long, G. V., Sullivan, R. J., Carlino, M. S., Menzies, A. M., & Johnson, D. B. (2023). Extended Follow-Up of Chronic Immune-Related Adverse Events Following Adjuvant Anti-PD-1 Therapy for High-Risk Resected Melanoma. *JAMA network open*, 6(8), e2327145. <https://doi.org/10.1001/jamanetworkopen.2023.27145>
- Zeraatkar, D., Ling, M., Kirsh, S., Jassal, T., Shahab, M., Movahed, H., Talukdar, J. R., Walch, A., Chakraborty, S., Turner, T., Turkstra, L., McIntyre, R. S., Izcovich, A., Mbuagbaw, L., Agoritsas, T., Flottorp, S. A., Garner, P., Pitre, T., Couban, R. J., & Busse, J. W. (2024). Interventions for the management of long covid (post-covid condition): living systematic review. *BMJ (Clinical research ed.)*, 387, e081318. <https://doi.org/10.1136/bmj-2024-081318>
- Murano, L., Damico, V., Cossalter, L., Riggio, M., Calabresi, F., Zappia, L., & Margosio, V. (2025). The impact of Mindfulness-based stress reduction on Covid-19 survivors. A

randomized controlled trial. *Annali di igiene : medicina preventiva e di comunita*, 37(3), 350–364. <https://doi.org/10.7416/ai.2025.2678>

Jackson, M., Jones, D., Dyson, J., & Macleod, U. (2019). Facilitated group work for people with long-term conditions: a systematic review of benefits from studies of group-work interventions. *The British journal of general practice : the journal of the Royal College of General Practitioners*, 69(682), e363–e372. <https://doi.org/10.3399/bjgp19X702233>

Neurocognitive Rehabilitation and Speech-Language Pathology for Long COVID

Sarah Stranburg, MA

Delgado-Alonso, C., Díez-Cirarda, M., Pagán, J., Pérez-Izquierdo, C., Oliver-Mas, S., Fernández-Romero, L., Martínez-Petit, Á., Valles-Salgado, M., Gil-Moreno, M. J., Yus, M., Matías-Guiu, J., Ayala, J. L., & Matias-Guiu, J. A. (2025). Unraveling brain fog in post-COVID syndrome: Relationship between subjective cognitive complaints and cognitive function, fatigue, and neuropsychiatric symptoms. *European Journal of Neurology*, 32(1), e16084. <https://doi.org/10.1111/ene.16084>

Ely, E. W., Brown, L. M., Fineberg, H. V., & National Academies of Sciences, Engineering, and Medicine Committee on Examining the Working Definition for Long Covid. (2024). Long Covid defined. *New England Journal of Medicine*, 391(18), 1746–1753. <https://doi.org/10.1056/NEJMs2408466>

Möller, M., Borg, K., Janson, C., Lerm, M., Normark, J., & Niward, K. (2023). Cognitive dysfunction in post-COVID-19 condition: Mechanisms, management, and rehabilitation. *Journal of Internal Medicine*, 294(5), 563–581. <https://doi.org/10.1111/joim.13720>

Sacks-Zimmerman, A., Bergquist, T. F., Farr, E. M., Cornwell, M. A., & Kanellopoulos, D. (2023). Rehabilitation of neuropsychiatric symptoms in patients with long COVID: Position statement. *Archives of Physical Medicine and Rehabilitation*, 104(2), 350–354. <https://doi.org/10.1016/j.apmr.2022.10.001>

Saunders, C., Sperling, S., & Bendstrup, E. (2023). A new paradigm is needed to explain long COVID. *Lancet Respiratory Medicine*, 11(2), e12–e13. [https://doi.org/10.1016/S2213-2600\(22\)00501-X](https://doi.org/10.1016/S2213-2600(22)00501-X)

Schultz, K. R., McGrath, S., Keary, T. A., Meng, C. K., Bathos, E., Evans, L., Fields, D., Cummings, A., & Fornalski, N. A. (2024). A multidisciplinary approach to assessment and management of long COVID cognitive concerns. *Life Science*, 357, 123068. <https://doi.org/10.1016/j.lfs.2024.123068>

World Health Organization. (2024, April 24). *Clinical management of COVID-19: Living guideline*. <https://www.who.int/teams/health-care-readiness/post-covid-19-condition>

Physical Therapy and Rehabilitation Management in Long COVID

Heidi Greata, PT, DPT

Courtney Matrunick, PT, DPT

#MEAction. (2022). *Post-viral ME/CFS: Diagnosing & treating ME/CFS in the time of COVID* [Video]. MEAction. <https://www.meaction.net/seminar/>

Assaf, G., Davis, H., & McCorkell, L. (2020). *What does COVID-19 recovery actually look like?* Patient-Led Research.

Centers for Disease Control and Prevention. (2021, April 30). *Treating the most disruptive symptoms first and preventing worsening of symptoms: Post-exertional malaise*. <https://www.cdc.gov/me-cfs/healthcare-providers/clinical-care-patients-mecfs/treating-most-disruptive-symptoms.html>

Cotler, J., Holtzman, C., Dudun, C., & Jason, L. A. (2018). A brief questionnaire to assess post-exertional malaise. *Diagnostics (Basel)*, 8(3), 66. <https://doi.org/10.3390/diagnostics8030066>

Crook, H., Raza, S., Nowell, J., Young, M., & Edison, P. (2021). Long COVID: Mechanisms, risk factors, and management. *BMJ*, 374, n1648. <https://doi.org/10.1136/bmj.n1648>

Davenport, T., Stevens, S., VanNess, M., Snell, C., & Little, T. (2010). Conceptual model for physical therapist management of chronic fatigue syndrome/myalgic encephalomyelitis. *Physical Therapy*, 90(4), 602–614.

Davis, H. E., Assaf, G. S., McCorkell, L., et al. (2020). Characterizing long COVID in an international cohort: 7 months of symptoms and their impact. *medRxiv*. <https://doi.org/10.1101/2020.12.24.20248802>

Espinoza-Bravo, C., Arnal-Gómez, A., Martínez-Arnau, F. M., et al. (2023). Effectiveness of functional or aerobic exercise combined with breathing techniques in telerehabilitation for patients with long COVID: A randomized controlled trial. *Physical Therapy*, 103(11), pzad118. <https://doi.org/10.1093/ptj/pzad118>

Ghali, A., Richa, P., Lacout, C., et al. (2020). Epidemiological and clinical factors associated with post-exertional malaise severity in ME/CFS patients. *Journal of Translational Medicine*, 18, 246. <https://doi.org/10.1186/s12967-020-02419-4>

- Komaroff, A. L., & Bateman, L. (2021). Will COVID-19 lead to myalgic encephalomyelitis/chronic fatigue syndrome? *Frontiers in Medicine*, 7, 606824. <https://doi.org/10.3389/fmed.2020.606824>
- Mateo, D., Chu, L., Stevens, S., Stevens, J., Snell, C., & Davenport, T. (2020). Post-exertional symptoms distinguish ME/CFS subjects from healthy controls. *Work*, 66, 265–275.
- MedBridge. (2013). *Post-exertional malaise: Pathophysiology and treatment* [Course]. Presented by Todd Davenport. MedBridge Education.
- Snell, C. R., Stevens, S. R., Davenport, T. E., & VanNess, J. M. (2013). Discriminative validity of metabolic and workload measurements for identifying people with chronic fatigue syndrome. *Physical Therapy*, 93(11).
- Wong, T. L., Welter, D. J. (2021). Long COVID and myalgic encephalomyelitis/chronic fatigue syndrome (ME/CFS): A systematic review and comparison of clinical presentation and symptomatology. *Medicina (Kaunas)*, 57(5), 418. <https://doi.org/10.3390/medicina57050418>
- Wong, J., Kudla, A., & Pham, T. (2021). Lessons learned by rehabilitation counselors and physicians in services to COVID-19 long haulers: A qualitative study. *Rehabilitation Counseling Bulletin*, 2021(00(0)). <https://doi.org/10.1177/00343552211060014>
- World Physiotherapy. (2021). *World Physiotherapy response to COVID-19: Briefing paper 9. Safe rehabilitation approaches for people living with long COVID: Physical activity and exercise*. London, UK: World Physiotherapy.
- Wormgoor, M., & Rehnsburg, S. C. (2021). The evidence base for physiotherapy in ME/CFS when considering post-exertional malaise: A systematic review and narrative synthesis. *Journal of Translational Medicine*, 19(1).
- Wright, J., Astill, S. L., & Sivan, M. (2022). The relationship between physical activity and long COVID: A cross-sectional study. *International Journal of Environmental Research and Public Health*, 19(9), 5093. <https://doi.org/10.3390/ijerph19095093>
- Ziauddeen, N., Gurdasani, D., O'Hara, M. E., et al. (2021). Characteristics of long COVID: Findings from a social media survey. *medRxiv*. <https://doi.org/10.1101/2021.03.21.21253968>

Zheng, C., Chen, X. K., Sit, C. H., et al. (2024). Effect of physical exercise-based interventions on long COVID: A systematic review and meta-analysis. *Medicine & Science in Sports & Exercise*, 56(1), 143–154. <https://doi.org/10.1249/MSS.00000000000003280>

Integrative and Lifestyle Medicine Approaches for Long COVID Care

Lauren Grossman, MD

Lopez-Leon, S., Wegman-Ostrosky, T., Perelman, C., Sepulveda, R., Rebolledo, P. A., Cuapio, A., & Villapol, S. (2021). More than 50 Long-term effects of COVID-19: a systematic review and meta-analysis. *medRxiv : the preprint server for health sciences*, 2021.01.27.21250617. <https://doi.org/10.1101/2021.01.27.21250617>

Niewolik, J., Mikuteit, M., Klawitter, S., Schröder, D., Stölting, A., Vahldiek, K., Heinemann, S., Müller, F., Behrens, G., Klawonn, F., Dopfer-Jablonka, A., & Steffens, S. (2024). Cluster analysis of long COVID symptoms for deciphering a syndrome and its long-term consequence. *Immunologic research*, 72(4), 605–613. <https://doi.org/10.1007/s12026-024-09465-w>

Peluso, M. J., & Deeks, S. G. (2024). Mechanisms of long COVID and the path toward therapeutics. *Cell*, 187(1), 1–17. <https://doi.org/10.1016/j.cell.2024.08.015>

Closing Remarks: An Update on the RECOVER Studies and Future Steps in Long-COVID

Andre Kumar, MD

American Academy of Physical Medicine and Rehabilitation. (n.d.). *Multidisciplinary PASC clinic guidance*. Retrieved June 2, 2025, from <https://www.aapmr.org/advocacy/current-priorities/long-covid-pasc/multidisciplinary-quality-improvement-initiative>

Canadian Post COVID-19 Condition Collaborative. (n.d.). *Canadian guidelines for post COVID-19 condition care*. Retrieved June 2, 2025, from <https://canpcc.ca/guidelines/>

National Institutes of Health. (n.d.). *RECOVER: Researching COVID to enhance recovery*. Retrieved June 2, 2025, from <https://recovercovid.org>