

The following content was supplied by the authors as supporting material and has not been copy-edited or verified by JBJS.

Appendix 1: Studies included in the Review

Author/year	Study Design	MSK manifestations
Daha ⁵ (2020)	Systematic Review	Rhabdomyolysis (14.46%), myalgia (32.7%).
Abdullahi ⁶ (2020)	Systematic Review and Meta-Analysis	Myalgia (19%), back pain (10%), muscle weakness (1.67%), skeletal muscle injury (1.67%), arthralgia (1.67%).
Ciaffi ⁷ (2020)	Systematic Review and Meta-Analysis	Myalgia, fatigue, arthralgia, chilblains.
Paliwal ⁸ (2020)	Systematic Review	Myalgia, myositis, rhabdomyolysis, critical-illness myopathy, cachexia, sarcopenia, myasthenia gravis exacerbation, Guillain-Barré syndrome.
Gawronska ⁹ (2021)	Systematic Review	Increased risk of falls.
Akbarialiabad ¹⁰ (2021)	Systematic Review	Fatigue, myalgia, muscle weakness, arthralgia, limb edema.
Crook ¹¹ (2021)	Systematic Review	Fatigue (11.9 – 93.5%).
Jiang ² (2021)	Literature Review	Chronic fatigue (up to 97.7%), arthralgia, myalgia.
Disser ¹² (2020)	Literature Review	Myalgia (25-50%), muscle weakness, atrophy, fatigue, arthralgia, bone mineral loss, osteonecrosis, chondrolysis.
Widyadharma ^{13, 14} (2020)	Literature Review	Fatigue, myalgia (11-62.5%), arthralgia (10-15%).
Wiersinga ¹⁵ (2020)	Literature Review	Fatigue (38%), myalgia (15-44%).
Garg ¹⁶ (2021)	Literature Review	Fatigue (28.3-98%), arthralgia (7.6-78.1%), myalgia.

Gu ¹⁷ (2021)	Literature Review	Urticarial vasculitis.
Ramani ¹⁸ (2021)	Literature Review	Myalgia (11-50%), myositis, rhabdomyolysis, myonecrosis, sarcopenia, arthralgia (2.5%), reactive arthritis, soft tissues abnormalities, rheumatologic diseases triggering (systemic lupus erythematosus, dermatomyositis, rheumatoid arthritis, psoriatic spondyloarthritis), muscle hematomas, distal extremities gangrene, osteonecrosis, osteoporosis, “Covid toes”.
Ali ¹⁹ (2021)	Literature Review	Myalgia, fatigue, muscle weakness.
Arkin ²⁰ (2021)	Literature Review	Pernio.
Shanbehzadeh ²¹ (2021)	Literature Review	Fatigue (28-87%), myalgia (4.5-36%), arthralgia (6-27%), muscle weakness (18.42%).
Zacharias ²² (2021)	Literature Review	Arthralgia (15%), myalgia (44%), reactive arthritis, rheumatoid arthritis, seronegative spondyloarthropathy, systemic lupus erythematosus, rhabdomyolysis, COVID-19 toes, Guillain-Barré syndrome.
Kanmaniraja ²³ (2021)	Literature Review	Myalgia (16-19%), back pain (10%), arthralgia and fatigue (26-36%), myositis, rhabdomyolysis, muscle denervation, intramuscular hematoma.
Ali ²⁴ (2021)	Literature Review	Myalgia, arthralgia, low back pain, cervical pain, avascular necrosis.
Hasan ²⁵ (2021)	Literature Review	Myopathy, Guillain-Barré syndrome, muscle weakness, reactive arthritis, myalgia and/or arthralgia (15.5%), new-onset backache (6.8%).
Selva-O’Callaghan ²⁶ (2021)	Literature Review	Immune-mediated necrotizing myopathies.

Rudroff ²⁷ (2021)	Literature Review	Higher muscle uptake in whole-body ¹⁸ F-FDG-PET/CT during acute stage and at 1-month follow-up.
Dewanjee ²⁸ (2021)	Literature Review	Theoretical increased risk of rheumatological disease flare or complications. Prevalence of symptomatic COVID-19 is two-fold in rheumatological patients compared to general population and, severity and death is also higher.
Knight ²⁹ (2021)	Literature Review	Evidence of association with autoimmunity, being a hypothetical risk factor for rheumatological diseases.
Saud ³⁰ (2021)	Literature Review	COVID-19 related myositis.
Egol ³¹ (2020)	Original Research	Increased morbidity and mortality in hip fracture patients. 30-day mortality (35.3% vs. 0.9%).
Batur ³² (2021)	Original Research	Myalgia (46.1%), fatigue (50%).
Al-Aly ³³ (2021)	Original Research	Fatigue (12.64%), muscle disorders (5.73%), musculoskeletal pain (13.89%), arthralgia and arthritis (5.16%).
Dallari ³⁴ (2021)	Original Research	Higher mortality in hip fracture in 30 days (15% vs. 2%).
Hoong ³⁵ (2021)	Original Research	Myalgia (37.5%), arthralgia (5.7%), new-onset backache (6.8%), body ache (50%).
Karaarslan ³⁶ (2021)	Original Research	Fatigue (44.3%), back pain (22.7%), arthralgia (22%), myalgia (21%), low back pain (16.3%), neck pain (10.3%); persistence of symptoms associated with BMI.
Oh ³⁷ (2021)	Original Research	Musculoskeletal disorders not associated with COVID-19 in hospital mortality.

Fike ³⁸ (2021)	Original Research	Rheumatic disease flare in latino cohort (OR 4.57 [95% CI 1.2-17.4]; <i>P</i> = 0.02).
Mahmoud ³⁹ (2021)	Original Research	Post-COVID-19: 77.3% of musculoskeletal manifestations (myalgia, arthralgia and fatigue).
Bakilan ⁴⁰ (2021)	Original Research	Fatigue (71.8%), spine pain (70.7% [11.4% neck pain, 30.4% back pain, 16.1% low back pain, 12.8% more than one site]), myalgia (60.7%), arthralgia (43.6% [3.2% hand, 0.7% elbow, 5.7% shoulder, 1.4% hip, 12.1% knee, 1.8% foot, 18.6% more than one site]).
Ursini ⁴¹ (2021)	Original Research	Clinical features of fibromyalgia are common in post COVID-19, “FibroCOVID”. Male (OR 9.95, 95% CI 6.02 to 16.43, <i>p</i> < 0.0001) and obesity (OR 41.20, 95% CI 18 to 98.88, <i>p</i> < 0.0001) are predictors.
Awosanya ⁴² (2021)	Original Research	Mouse model: 24.4% decrease in trabecular bone volume fraction (<i>p</i> =0.0009), 19.0% decrease in trabecular number (<i>p</i> =0.004), 6.2% decrease in trabecular thickness (<i>p</i> =0.04), 9.8% increase in trabecular separation (<i>p</i> =0.04), 64% increase in osteoclast number, 27% increase in osteoclast surface, 38% increase in osteoclasts per bone surface and, no differences in cortical bone parameters.
Aly ⁴³ (2021)	Original Research	Joint pain (8.7%), weakness (10.4%), myalgia (15.7%), joint pain + weakness (2.6%), joint pain + myalgia (3.5%), weakness + myalgia (1.7%), joint pain + weakness + myalgia (6.1%), fatigue (57.4%), recurrent falls (25.2%).
Terlizzi ⁴⁴ (2021)	Original Research	Malaise and fatigue (10-13%), musculoskeletal pain (5% subacute, 13% prolonged, none persistent). Subacute (up to 3 months), Prolonged (3 to 6 months), Persistent (> 6 months).

Karaarslan ⁴⁵ (2021)	Original Research	Long covid: fatigue (31.6%), joint pain (18.6%), myalgia (15.1%). Female more likely to have these symptoms.
Suh ⁴⁶ (2021)	Original Research	Histopathology of SARS-CoV-2 fatal patients presenting inflammatory/immune-mediated damage in muscle and neural tissues.
Ali ⁴⁷ (2021)	Original Research	Myalgia (28%), muscle tenderness and weakness (3.9%), skeletal muscle injury (35.7%), rhabdomyolysis (15.7%). The mortality associated with rhabdomyolysis is 13.8%.
Pitscheider ⁴⁸ (2021)	Original Research	Creatine kinase (CK) elevation was associated with disease severity and markers of inflammation.
Shelley ⁴⁹ (2021)	Original Research	Following SARS-CoV-2 recovery 48% reported difficulty in exercise.
Aschman ⁵⁰ (2021)	Original Research	Skeletal muscle histopathology showed higher pathology score and inflammation score, and increased MHC class I antigens, MHC class II antigens, natural killer cells.
Colombini ⁵¹ (2021)	Original Research	Older patients with lower limbs fracture showed higher prevalence of long-term sequelae in COVID-19 positive patients.
Hameed ⁵² (2021)	Original Research	Myopathy, axonal neuropathy and Guillain-Barré syndrome.
Bai ⁵³ (2021)	Original Research	Fatigue (39.5%) and MSK pain (21.2%).
Umbrello ⁵⁴ (2021)	Original Research	Outcomes of severe COVID-19 patients were associated with muscle mass reduction.
Gerard ⁵⁵ (2021)	Original Research	Muscle strength loss is a symptom of Long-COVID-19, which can lead to long-term disability. Obese are more

		frequently affected muscle impairment and ICU admissions.
Qin ⁵⁶ (2021)	Original Research	COVID-19 survivors commonly present new functional impairments at 30 days after discharge.
Tuzun ⁵⁷ (2021)	Original Research	Fatigue (85.3%), myalgia (68%), arthralgia (43.3%), back pain (22%). Severe female patients presented lower grip strength.
Fernández-de-las-Peñas ⁵⁸ (2021)	Original Research	Myalgia early in the disease course was associated with MSK Post-COVID-19 pain against patients without muscle pain (OR 1.41; 95% CI 1.04-1.90).
Geng ⁵⁹ (2021)	Original Research	Rhabdomyolysis (2.2%). Rhabdomyolysis was associated with greater ICU admission, higher incidence of mechanical ventilation, higher risk of in-hospital mortality and, longer viral shedding.
Fernández-de-las-Peñas ⁶⁰ (2021)	Original Research	MSK Post-COVID-19 pain (45.1% of survivors at 8 months). The risk factors identified were long hospital stay, female sex, previous MSK pain and, acute phase with myalgia and headache.
Jafarnezhadgero ⁶¹ (2022)	Original Research	Impairment of running kinetics and muscle activity.
Ascani ⁶² (2021)	Case Series	Adhesive capsulitis of the shoulder in 12 patients.
Mukarram ⁶³ (2021)	Case Series	Inflammatory arthritis in 5 patients, resembling rheumatoid arthritis.
Anaya ⁶⁴ (2021)	Case Series	Acute: fatigue (79%), myalgia (66%), arthralgia (62%). Post-COVID: arthralgia (65%), back pain (55%), weakness (46%), myalgia (42%), body pain (40%), fatigue (34%), sarcopenia (28%).

Alvarez ⁶⁵ (2021)	Case Series	Shoulder pain in 20 patients out of 116 after mechanical ventilation.
Talamonti ⁶⁶ (2021)	Case Series	Primary spinal epidural abscess in six COVID-19 patients.
Vergori ⁶⁷ (2021)	Case Series	Ilio-psoas spontaneous haematomas in seven severe SARS-CoV-2 patients.
Bagnato ⁶⁸ (2020)	Case Report	Critical illness myopathy.
Husain ⁶⁹ (2020)	Case Report	Rhabdomyolysis.
Soliman ⁷⁰ (2020)	Case Report	COVID-19-associated peripheral polyneuropathy diagnosed with MSK ultrasound in two patients.
Hasbani ⁷¹ (2021)	Case Report	Axial and peripheral spondyloarthritis in two patients.
Bahout ⁷² (2021)	Case Report	Muscle denervation atrophy in one patient.
Uslu ⁷³ (2021)	Case Report	Myositis.
Veyseh ⁷⁴ (2021)	Case Report	IgG-related autoimmune inflammatory necrotizing myositis.
Kopacz ⁷⁵ (2021)	Case Report	“COVID-19 toes”.
Omololu ⁷⁶ (2021)	Case Report	Fatigue and polyarthritis for 18 weeks in one patient.
Cincinelli ⁷⁷ (2021)	Case Report	Monoarthritis.
Byler ⁷⁸ (2021)	Case Report	Rhabdomyolysis.
Agarwala ⁷⁹ (2021)	Case Report	Avascular necrosis of the femoral head in three patients.
Neves ⁸⁰ (2021)	Case Report	Bilateral shoulder infectious arthritis in one patient.
Dumitru ⁸¹ (2021)	Case Report	Latent muscular dystrophy activation. Patient manifesting Emery-Dreifuss Syndrome after SARS-CoV-2 infection.

Novelli ⁸² (2021)	Case Report	Psoriatic arthritis.
Shahidi ⁸³ (2021)	Case Report	Dermatomyositis-lupus overlap syndrome.
Abrams ⁸⁴ (2021)	Case Report	Elsberg Syndrome.
Ito ⁸⁵ (2021)	Case Report	Bilateral spontaneous iliopsoas hematomas in two patients.
Ducatez ⁸⁶ (2021)	Case Report	Primary meningococcal arthritis of the knee.
Drosos ⁸⁷ (2021)	Case Report	Seronegative rheumatoid arthritis.
Angulo-Ardoy ⁸⁸ (2021)	Case Report	Osteonecrosis of the right knee.
McBride ⁸⁹ (2021)	Case Report	Retiform purpura on the sacrum/buttocks.
Trinity ⁹⁰ (2021)	Case Report	Presymptomatic impact of COVID-19 with attenuated passive leg movement, decreased leg blood flow during knee extension exercise, decreased strength and mitochondrial function, IL-10 elevation.
Collins ⁹¹ (2022)	Case Report	Severe post-COVID-19 costochondritis.
Welch ⁹² (2020)	Specialist opinion	Acute sarcopenia.
Morley ⁹³ (2020)	Editorial	Sarcopenia and cachexia.
Cipollaro ⁹⁴ (2020)	Editorial	Fatigue (26.5%) and arthralgia / myalgia (15.5%).
Vaishya ⁹⁵ (2021)	Editorial	Fatigue, myalgia, arthralgia, muscle weakness, limb gangrene, COVID-19 toes, hematomas, reactive arthritis, bone mineral density decrease, osteoporosis, osteonecrosis.
Snowden ⁹⁶ (2022)	Editorial	Avascular necrosis of the femoral head.
Bagaria ⁹⁷ (2021)	Letter to the Editor	Arthralgia, myalgia, primary septic joint infection, elevation of post-operative

Stoira ⁹⁸ (2021)	Letter to the Editor	infection rates, synovitis, spontaneous osteonecrosis, soft tissue abscess. 10 out of 52 severe COVID-19 patients developed extensive heterotopic ossification (shoulder, elbow and hip). Heterotopic ossification was associated with longer mechanical ventilation (OR 2.64 for each additional week; 95% CI 1.26-5.51; p 0.009) and longer hospital stay (OR 2.1 for each additional week; 95% CI 1.3-3.4; p 0.004).
-----------------------------	----------------------	--

References

1. COVID-19 Weekly Epidemiological Update. WHO, 2021.
2. Jiang DH, Roy DJ, Gu BJ, Hassett LC, McCoy RG. Postacute Sequelae of Severe Acute Respiratory Syndrome Coronavirus 2 Infection: A State-of-the-Art Review. *JACC Basic Transl Sci.* 2021 Sep-Oct;6(9):796-811. Epub 2021/09/21.
3. Ioannidis JPA. Infection fatality rate of COVID-19 inferred from seroprevalence data. *Bull World Health Organ.* 2021 Jan 1;99(1):19-33F. Epub 2021/03/16.
4. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ.* 2021 Mar 29;372:n71. Epub 2021/03/31.
5. Daha SK, Koirala B, Chapagain D, Lohani P, Acharya S, Sharma P. Clinical features and management of COVID-19: A systematic review. *Tropical Biomedicine.* 2020;37(2):409-20.
6. Abdullahi A, Candan SA, Abba MA, Bello AH, Alshehri MA, Afamefuna Victor E, et al. Neurological and Musculoskeletal Features of COVID-19: A Systematic Review and Meta-Analysis. *Front Neurol.* 2020;11:687. Epub 2020/07/18.
7. Ciaffi J, Meliconi R, Ruscitti P, Berardicurti O, Giacomelli R, Ursini F. Rheumatic manifestations of COVID-19: a systematic review and meta-analysis. *BMC Rheumatol.* 2020;4:65. Epub 2020/10/31.
8. Paliwal VK, Garg RK, Gupta A, Tejan N. Neuromuscular presentations in patients with COVID-19. *Neurol Sci.* 2020 Nov;41(11):3039-56. Epub 2020/09/17.
9. Gawronska K, Lorkowski J. Falls as One of the Atypical Presentations of COVID-19 in Older Population. *Geriatr Orthop Surg Rehabil.* 2021;12:2151459321996619. Epub 2021/03/09.

10. Akbarialiabad H, Taghrir MH, Abdollahi A, Ghahramani N, Kumar M, Paydar S, et al. Long COVID, a comprehensive systematic scoping review. *Infection*. 2021 Jul 28. Epub 2021/07/29.
11. Crook H, Raza S, Nowell J, Young M, Edison P. Long covid-mechanisms, risk factors, and management. *BMJ*. 2021 Jul 26;374:n1648. Epub 2021/07/28.
12. Disser NP, De Micheli AJ, Schonk MM, Konnaris MA, Piacentini AN, Edon DL, et al. Musculoskeletal Consequences of COVID-19. *J Bone Joint Surg Am*. 2020 Jul 15;102(14):1197-204. Epub 2020/07/18.
13. Widyadharma IPE, Dewi PR, Wijayanti IAS, Utami DKI. Pain related viral infections: a literature review. *Egypt J Neurol Psychiatr Neurosurg*. 2020;56(1):105. Epub 2020/11/11.
14. Widyadharma IPE, Sari N, Pradnyaswari KE, Yuwana KT, Adikarya I, Tertia C, et al. Pain as clinical manifestations of COVID-19 infection and its management in the pandemic era: a literature review. *Egypt J Neurol Psychiatr Neurosurg*. 2020;56(1):121. Epub 2021/01/05.
15. Wiersinga WJ, Rhodes A, Cheng AC, Peacock SJ, Prescott HC. Pathophysiology, Transmission, Diagnosis, and Treatment of Coronavirus Disease 2019 (COVID-19): A Review. *JAMA*. 2020 Aug 25;324(8):782-93. Epub 2020/07/11.
16. Garg M, Maralakunte M, Garg S, Dhooria S, Sehgal I, Bhalla AS, et al. The Conundrum of 'Long-COVID-19': A Narrative Review. *Int J Gen Med*. 2021;14:2491-506. Epub 2021/06/25.
17. Gu SL, Jorizzo JL. Urticarial vasculitis. *Int J Womens Dermatol*. 2021 Jun;7(3):290-7. Epub 2021/07/06.

18. Ramani SL, Samet J, Franz CK, Hsieh C, Nguyen CV, Horbinski C, et al. Musculoskeletal involvement of COVID-19: review of imaging. *Skeletal Radiol*. 2021 Sep;50(9):1763-73. Epub 2021/02/19.
19. Ali AM, Kunugi H. Skeletal Muscle Damage in COVID-19: A Call for Action. *Medicina (Kaunas)*. 2021 Apr 12;57(4). Epub 2021/05/01.
20. Arkin LM, Moon JJ, Tran JM, Asgari S, O'Farrelly C, Casanova JL, et al. From Your Nose to Your Toes: A Review of Severe Acute Respiratory Syndrome Coronavirus 2 Pandemic Associated Pernio. *J Invest Dermatol*. 2021 Jul 15. Epub 2021/09/26.
21. Shanbehzadeh S, Tavahomi M, Zanjari N, Ebrahimi-Takamjani I, Amiri-Arimi S. Physical and mental health complications post-COVID-19: Scoping review. *J Psychosom Res*. 2021 Aug;147:110525. Epub 2021/05/30.
22. Zacharias H, Dubey S, Koduri G, D'Cruz D. Rheumatological complications of Covid 19. *Autoimmun Rev*. 2021 Sep;20(9):102883. Epub 2021/07/09.
23. Kanmaniraja D, Le J, Hsu K, Lee JS, McClelland A, Slasky SE, et al. Review of COVID-19, part 2: Musculoskeletal and neuroimaging manifestations including vascular involvement of the aorta and extremities. *Clin Imaging*. 2021 Nov;79:300-13. Epub 2021/08/14.
24. Ali S, Singh A, Sharief N, Yadav M, Siddiqui S, Pandey V, et al. Coronaviruses: An overview with special emphasis on COVID-19 outbreak with musculoskeletal manifestations. *World J Orthop*. 2021 Sep 18;12(9):620-8. Epub 2021/10/12.
25. Hasan LK, Deadwiler B, Haratian A, Bolia IK, Weber AE, Petrigliano FA. Effects of COVID-19 on the Musculoskeletal System: Clinician's Guide. *Orthop Res Rev*. 2021;13:141-50. Epub 2021/09/30.

26. Selva-O'Callaghan A, Trallero-Araguas E, Milisenda JC, Grau-Junyent JM. Differential diagnosis of necrotizing myopathy. *Curr Opin Rheumatol*. 2021 Nov 1;33(6):544-53. Epub 2021/09/06.
27. Rudroff T, Workman CD, Ponto LLB. (18)F-FDG-PET Imaging for Post-COVID-19 Brain and Skeletal Muscle Alterations. *Viruses*. 2021 Nov 15;13(11). Epub 2021/11/28.
28. Dewanjee S, Kandimalla R, Kalra RS, Valupadas C, Vallamkondu J, Kolli V, et al. COVID-19 and Rheumatoid Arthritis Crosstalk: Emerging Association, Therapeutic Options and Challenges. *Cells*. 2021 Nov 24;10(12). Epub 2021/12/25.
29. Knight JS, Caricchio R, Casanova JL, Combes AJ, Diamond B, Fox SE, et al. The intersection of COVID-19 and autoimmunity. *J Clin Invest*. 2021 Dec 15;131(24). Epub 2021/10/29.
30. Saud A, Naveen R, Aggarwal R, Gupta L. COVID-19 and Myositis: What We Know So Far. *Curr Rheumatol Rep*. 2021 Jul 3;23(8):63. Epub 2021/07/04.
31. Egol KA, Konda SR, Bird ML, Dedhia N, Landes EK, Ranson RA, et al. Increased Mortality and Major Complications in Hip Fracture Care During the COVID-19 Pandemic: A New York City Perspective. *J Orthop Trauma*. 2020 Aug;34(8):395-402. Epub 2020/06/03.
32. Batur EB, Korez MK, Gezer IA, Levendoglu F, Ural O. Musculoskeletal symptoms and relationship with laboratory findings in patients with COVID-19. *Int J Clin Pract*. 2021 Jun;75(6):e14135. Epub 2021/03/10.
33. Al-Aly Z, Xie Y, Bowe B. High-dimensional characterization of post-acute sequelae of COVID-19. *Nature*. 2021 Jun;594(7862):259-64. Epub 2021/04/23.
34. Dallari D, Zagra L, Cimatti P, Guindani N, D'Apolito R, Bove F, et al. Early mortality in hip fracture patients admitted during first wave of the COVID-19 pandemic in Northern Italy: a multicentre study. *J Orthop Traumatol*. 2021 Apr 5;22(1):15. Epub 2021/04/06.

35. Hoong CWS, Amin M, Tan TC, Lee JE. Viral arthralgia a new manifestation of COVID-19 infection? A cohort study of COVID-19-associated musculoskeletal symptoms. *Int J Infect Dis.* 2021 Mar;104:363-9. Epub 2021/01/22.
36. Karaarslan F, Demircioglu Guneri F, Kardes S. Postdischarge rheumatic and musculoskeletal symptoms following hospitalization for COVID-19: prospective follow-up by phone interviews. *Rheumatol Int.* 2021 Jul;41(7):1263-71. Epub 2021/05/13.
37. Oh TK, Song IA, Lee J, Eom W, Jeon YT. Musculoskeletal Disorders, Pain Medication, and in-Hospital Mortality among Patients with COVID-19 in South Korea: A Population-Based Cohort Study. *Int J Environ Res Public Health.* 2021 Jun 24;18(13). Epub 2021/07/03.
38. Fike A, Hartman J, Redmond C, Williams SG, Ruiz-Perdomo Y, Chu J, et al. Risk Factors for COVID-19 and Rheumatic Disease Flare in a US Cohort of Latino Patients. *Arthritis Rheumatol.* 2021 Jul;73(7):1129-34. Epub 2021/01/18.
39. Mahmoud MH, Alghamdi FA, Alghamdi GA, Alkhotani LA, Alrehaili MA, El-Deeb DK. Study of Post-COVID-19 Syndrome in Saudi Arabia. *Cureus.* 2021 Sep;13(9):e17787. Epub 2021/10/19.
40. Bakilan F, Gokmen IG, Ortanca B, Ucan A, Eker Guvenc S, Sahin Mutlu F, et al. Musculoskeletal symptoms and related factors in postacute COVID-19 patients. *Int J Clin Pract.* 2021 Nov;75(11):e14734. Epub 2021/08/14.
41. Ursini F, Ciaffi J, Mancarella L, Lisi L, Brusi V, Cavallari C, et al. Fibromyalgia: a new facet of the post-COVID-19 syndrome spectrum? Results from a web-based survey. *RMD Open.* 2021 Aug;7(3). Epub 2021/08/25.
42. Awosanya OD, Dalloul CE, Blosser RJ, Dadwal UC, Carozza M, Boschen K, et al. Osteoclast-mediated bone loss observed in a COVID-19 mouse model. *Bone.* 2021 Oct 2;154:116227. Epub 2021/10/05.

43. Aly M, Saber HG. Long COVID and chronic fatigue syndrome: A survey of elderly female survivors in Egypt. *Int J Clin Pract*. 2021 Sep 19:e14886. Epub 2021/09/20.
44. Terlizzi K, Kutscher E, Yoncheva Y. Monitoring New Symptoms After COVID-19 Infection Among Primary Care Patients in New York City. *J Am Board Fam Med*. 2021 Sep-Oct;34(5):1014-6. Epub 2021/09/19.
45. Karaarslan F, Guneri FD, Kardes S. Long COVID: rheumatologic/musculoskeletal symptoms in hospitalized COVID-19 survivors at 3 and 6 months. *Clin Rheumatol*. 2021 Oct 29. Epub 2021/10/30.
46. Suh J, Mukerji SS, Collens SI, Padera RF, Jr., Pinkus GS, Amato AA, et al. Skeletal Muscle and Peripheral Nerve Histopathology in COVID-19. *Neurology*. 2021 Aug 24;97(8):e849-e58. Epub 2021/06/09.
47. Ali L, Mohammed I, Janjua I, Naeem M, Adeli G, Elalamy O, et al. Acute Myocardial Injury and Rhabdomyolysis in COVID-19 Patients: Incidence and Mortality. *Cureus*. 2021 Oct;13(10):e18899. Epub 2021/11/23.
48. Pitscheider L, Karolyi M, Burkert FR, Helbok R, Wanschitz JV, Horlings C, et al. Muscle involvement in SARS-CoV-2 infection. *Eur J Neurol*. 2021 Oct;28(10):3411-7. Epub 2020/10/01.
49. Shelley J, Hudson J, Mackintosh KA, Saynor ZL, Duckers J, Lewis KE, et al. 'I Live a Kind of Shadow Life': Individual Experiences of COVID-19 Recovery and the Impact on Physical Activity Levels. *Int J Environ Res Public Health*. 2021 Oct 29;18(21). Epub 2021/11/14.
50. Aschman T, Schneider J, Greuel S, Meinhardt J, Streit S, Goebel HH, et al. Association Between SARS-CoV-2 Infection and Immune-Mediated Myopathy in Patients Who Have Died. *JAMA Neurol*. 2021 Aug 1;78(8):948-60. Epub 2021/06/12.

51. Colombini A, Lombardo MDM, de Girolamo L, De Vecchi E, Giorgino R, Peretti GM, et al. COVID-19 in Elderly Patients Surgically Treated for Lower Limbs Fracture. *J Clin Med*. 2021 Dec 29;11(1). Epub 2022/01/12.
52. Hameed S, Khan AF, Khan S. Electrodiagnostic findings in COVID-19 patients: A single center experience. *Clin Neurophysiol*. 2021 Dec;132(12):3019-24. Epub 2021/10/31.
53. Bai F, Tomasoni D, Falcinella C, Barbanotti D, Castoldi R, Mule G, et al. Female gender is associated with long COVID syndrome: a prospective cohort study. *Clin Microbiol Infect*. 2021 Nov 9. Epub 2021/11/12.
54. Umbrello M, Guglielmetti L, Formenti P, Antonucci E, Cereghini S, Filardo C, et al. Qualitative and quantitative muscle ultrasound changes in patients with COVID-19-related ARDS. *Nutrition*. 2021 Nov-Dec;91-92:111449. Epub 2021/09/29.
55. Gerard M, Mahmutovic M, Malgras A, Michot N, Scheyer N, Jaussaud R, et al. Long-Term Evolution of Malnutrition and Loss of Muscle Strength after COVID-19: A Major and Neglected Component of Long COVID-19. *Nutrients*. 2021 Nov 6;13(11). Epub 2021/11/28.
56. Qin ES, Gold LS, Hough CL, Katz PP, Bunnell AE, Wysham KD, et al. Patient-reported functional outcomes 30 days after hospitalization for COVID-19. *PM R*. 2021 Sep 29. Epub 2021/09/30.
57. Tuzun S, Keles A, Okutan D, Yildiran T, Palamar D. Assessment of musculoskeletal pain, fatigue and grip strength in hospitalized patients with COVID-19. *Eur J Phys Rehabil Med*. 2021 Aug;57(4):653-62. Epub 2021/01/05.
58. Fernández-de-las-Peñas C, Rodríguez-Jiménez J, Fuensalida-Novo S, Palacios-Ceña M, Gómez-Mayordomo V, Florencio LL, et al. Myalgia as a symptom at hospital admission by severe acute respiratory syndrome coronavirus 2 infection is associated with persistent

musculoskeletal pain as long-term post-COVID sequelae: a case-control study. *PAIN*. 2021;162(12):2832-40.

59. Geng Y, Ma Q, Du YS, Peng N, Yang T, Zhang SY, et al. Rhabdomyolysis is Associated with In-Hospital Mortality in Patients with COVID-19. *Shock*. 2021 Sep 1;56(3):360-7. Epub 2021/01/15.

60. Fernández-de-las-Peñas C, de-la-Llave-Rincón AI, Ortega-Santiago R, Ambite-Quesada S, Gómez-Mayordomo V, Cuadrado ML, et al. Prevalence and risk factors of musculoskeletal pain symptoms as long-term post-COVID sequelae in hospitalized COVID-19 survivors: a multicenter study. *PAIN*. 2021.

61. Jafarnezhadgero AA, Hamlabadi MP, Sajedi H, Granacher U. Recreational runners who recovered from COVID-19 show different running kinetics and muscle activities compared with healthy controls. *Gait Posture*. 2022 Jan;91:260-5. Epub 2021/11/15.

62. Ascani C, Passaretti D, Scacchi M, Bullitta G, De Cupis M, Pasqualetto M, et al. Can adhesive capsulitis of the shoulder be a consequence of COVID-19? Case series of 12 patients. *J Shoulder Elbow Surg*. 2021 Jul;30(7):e409-e13. Epub 2021/05/09.

63. Mukarram MS, Ishaq Ghauri M, Sethar S, Afsar N, Riaz A, Ishaq K. COVID-19: An Emerging Culprit of Inflammatory Arthritis. *Case Rep Rheumatol*. 2021;2021:6610340. Epub 2021/05/15.

64. Anaya JM, Rojas M, Salinas ML, Rodriguez Y, Roa G, Lozano M, et al. Post-COVID syndrome. A case series and comprehensive review. *Autoimmun Rev*. 2021 Nov;20(11):102947. Epub 2021/09/13.

65. Alvarez R, Del Valle MF, Cordero P, Del Sol M, Lizana PA, Gutierrez J, et al. Shoulder Pain in COVID-19 Survivors Following Mechanical Ventilation. *Int J Environ Res Public Health*. 2021 Oct 3;18(19). Epub 2021/10/14.

66. Talamonti G, Colistra D, Crisa F, Cenzato M, Giorgi P, D'Aliberti G. Spinal epidural abscess in COVID-19 patients. *J Neurol*. 2021 Jul;268(7):2320-6. Epub 2020/09/11.
67. Vergori A, Pianura E, Lorenzini P, D'Abramo A, Di Stefano F, Grisetti S, et al. Spontaneous ilio-psoas haematomas (IPHs): a warning for COVID-19 inpatients. *Ann Med*. 2021 Dec;53(1):295-301. Epub 2021/01/26.
68. Bagnato S, Boccagni C, Marino G, Prestandrea C, D'Agostino T, Rubino F. Critical illness myopathy after COVID-19. *Int J Infect Dis*. 2020 Oct;99:276-8. Epub 2020/08/09.
69. Husain R, Corcuera-Solano I, Dayan E, Jacobi AH, Huang M. Rhabdomyolysis as a manifestation of a severe case of COVID-19: A case report. *Radiol Case Rep*. 2020 Sep;15(9):1633-7. Epub 2020/07/22.
70. Soliman SB, Klochko CL, Dhillon MK, Vandermissen NR, van Holsbeeck MT. Peripheral Polyneuropathy Associated with COVID-19 in Two Patients: A Musculoskeletal Ultrasound Case Report. *J Med Ultrasound*. 2020 Oct-Dec;28(4):249-52. Epub 2021/03/05.
71. Hasbani GE, Jawad ASM, Uthman I. Axial and peripheral spondyloarthritis triggered by sars-cov-2 infection: a report of two cases. *Reumatismo*. 2021;73(1):59-63.
72. Bahouth S, Chuang K, Olson L, Rosenthal D. COVID-19 related muscle denervation atrophy. *Skeletal Radiol*. 2021 Aug;50(8):1717-21. Epub 2021/02/01.
73. Uslu S. Myositis due to COVID-19. *Postgraduate medical journal*. 2021;0(1).
74. Veyseh M, Koyoda S, Ayesha B. COVID-19 IgG-related autoimmune inflammatory necrotizing myositis. *BMJ Case Rep*. 2021 Apr 13;14(4). Epub 2021/04/15.
75. Kopacz A, Ludwig C, Tarbox M. Atypical cutaneous and musculoskeletal manifestation of SARS-CoV-2: 'COVID-19 toes' and spasticity in a 48-year-old woman. *BMJ Case Rep*. 2021 Mar 17;14(3). Epub 2021/03/19.

76. Omololu A, Ojelade B, Ajayi O, Adesomi T, Alade O, Adebisi S, et al. “Long COVID”: A case report of persistent symptoms in a patient with prolonged SARS-CoV-2 shedding for over 110 days. *SAGE Open Medical Case Reports*. 2021;9:1-3.
77. Cincinelli G, Di Taranto R, Orsini F, Rindone A, Murgo A, Caporali R. A case report of monoarthritis in a COVID-19 patient and literature review: Simple actions for complex times. *Medicine (Baltimore)*. 2021 Jun 11;100(23):e26089. Epub 2021/06/12.
78. Byler J, Harrison R, Fell LL. Rhabdomyolysis Following Recovery from Severe COVID-19: A Case Report. *Am J Case Rep*. 2021 May 8;22:e931616. Epub 2021/05/09.
79. Agarwala SR, Vijayvargiya M, Pandey P. Avascular necrosis as a part of 'long COVID-19'. *BMJ Case Rep*. 2021 Jul 2;14(7). Epub 2021/07/04.
80. Neves TR, Lourenco AL, Alves P, Teiga C, Caetano AP. Bilateral shoulder arthritis in COVID-19 patient after prolonged mechanical ventilation assist: a case report. *Radiol Case Rep*. 2021 Oct;16(10):2894-8. Epub 2021/08/10.
81. Dumitru IM, Vlad ND, Rugina S, Onofrei N, Gherca S, Raduna M, et al. SARS-CoV-2 Infection and Emery-Dreifuss Syndrome in a Young Patient with a Family History of Dilated Cardiomyopathy. *Genes (Basel)*. 2021 Jul 14;12(7). Epub 2021/08/07.
82. Novelli L, Motta F, Ceribelli A, Guidelli GM, Luciano N, Isailovic N, et al. A case of psoriatic arthritis triggered by SARS-CoV-2 infection. *Rheumatology (Oxford)*. 2021 Jan 5;60(1):e21-e3. Epub 2020/11/19.
83. Shahidi Dadras M, Rakhshan A, Ahmadzadeh A, Hosseini SA, Diab R, Safari Giv T, et al. Dermatomyositis-lupus overlap syndrome complicated with cardiomyopathy after SARS-CoV-2 infection: A new potential trigger for musculoskeletal autoimmune disease development. *Clin Case Rep*. 2021 Oct;9(10):e04931. Epub 2021/10/21.

84. Abrams R, Desland F, Lehrer H, Yeung A, Tse W, Young JJ, et al. A Case of Elsberg Syndrome in the Setting of Asymptomatic SARS-CoV-2 Infection [Report]. *Journal of Clinical Neuromuscular Disease*. 2021;22(4):228-31.
85. Ito Y, Awano N, Uchiyama F, Inomata M, Kuse N, Tone M, et al. Spontaneous Muscle Hematoma in Japanese Patients with Severe COVID-19 Treated with Unfractionated Heparin: Two Case Reports. *Intern Med*. 2021 Nov 1;60(21):3503-6. Epub 2021/08/27.
86. Ducatez N, Chancel M, Douadi Y, Dayen C, Suguenot R, Lecuyer E, et al. Primary meningococcal arthritis in a COVID-19 18-year-old man: a case report and review of the literature. *BMC Infect Dis*. 2021 May 29;21(1):499. Epub 2021/05/31.
87. Drosos AA, Pelechas E, Voulgari PV. Seronegative Erosive Arthritis Following SARS-CoV-2 Infection. *Rheumatol Ther*. 2021 Nov 16. Epub 2021/11/18.
88. Angulo-Ardoy M, Urena-Aguilera A. Knee osteonecrosis after COVID-19. *Fam Pract*. 2021 Aug 27;38(Suppl 1):i45-i7. Epub 2021/08/28.
89. McBride JD, Narang J, Simonds R, Agrawal S, Rodriguez ER, Tan CD, et al. Development of sacral/buttock retiform purpura as an ominous presenting sign of COVID-19 and clinical and histopathologic evolution during severe disease course. *J Cutan Pathol*. 2021 Sep;48(9):1166-72. Epub 2021/05/02.
90. Trinity JD, Craig JC, Fermoye CC, McKenzie AI, Lewis MT, Park SH, et al. Impact of presymptomatic COVID-19 on vascular and skeletal muscle function: a case study. *J Appl Physiol (1985)*. 2021;130(6):1961-70.
91. Collins RA, Ray N, Ratheal K, Colon A. Severe post-COVID-19 costochondritis in children. *Proc (Bayl Univ Med Cent)*. 2022;35(1):56-7. Epub 2021/12/31.
92. Welch C, Greig C, Masud T, Wilson D, Jackson TA. COVID-19 and Acute Sarcopenia. *Aging Dis*. 2020 Dec;11(6):1345-51. Epub 2020/12/04.

93. Morley JE, Kalantar-Zadeh K, Anker SD. COVID-19: a major cause of cachexia and sarcopenia? *J Cachexia Sarcopenia Muscle*. 2020 Aug;11(4):863-5. Epub 2020/06/11.
94. Cipollaro L, Giordano L, Padulo J, Oliva F, Maffulli N. Musculoskeletal symptoms in SARS-CoV-2 (COVID-19) patients. *J Orthop Surg Res*. 2020 May 18;15(1):178. Epub 2020/05/20.
95. Vaishya R, Jain VK, Iyengar KP. Musculoskeletal manifestations of COVID-19. *J Clin Orthop Trauma*. 2021 Jun;17:280-1. Epub 2021/03/16.
96. Snowden GT, Clement ND, Zhang S, Xue Q, Simpson A. Orthopaedic long COVID - the unknown unknowns : are we facing a pandemic of avascular necrosis following COVID-19? *Bone Joint Res*. 2022 Jan;11(1):10-1. Epub 2022/01/12.
97. Bagaria V. Usual and Unusual Musculoskeletal Sequelae of COVID 19! *Indian J Orthop*. 2021 May 3:1-2. Epub 2021/05/11.
98. Stoira E, Elzi L, Puligheddu C, Garibaldi R, Voinea C, Chiesa AF. High prevalence of heterotopic ossification in critically ill patients with severe COVID-19. *Clinical Microbiology and Infection*. 2021 Jul;27(7):1049-50. Epub 2021/01/19.
99. Gupta A, Madhavan MV, Sehgal K, Nair N, Mahajan S, Sehrawat TS, et al. Extrapulmonary manifestations of COVID-19. *Nat Med*. 2020 Jul;26(7):1017-32. Epub 2020/07/12.
100. Ombrello MJ, Schulert GS. COVID-19 and cytokine storm syndrome: are there lessons from macrophage activation syndrome? *Transl Res*. 2021 Jun;232:1-12. Epub 2021/03/09.
101. Shah W, Hillman T, Playford ED, Hishmeh L. Managing the long term effects of covid-19: summary of NICE, SIGN, and RCGP rapid guideline. *BMJ*. 2021 Jan 22;372:n136. Epub 2021/01/24.

102. Zaladonis A, Huang S, Hsu S. COVID toes or pernio? *Clin Dermatol*. 2020 Nov - Dec;38(6):764-7. Epub 2020/12/21.
103. Jacob-Nascimento LC, Carvalho CX, Silva MMO, Kikuti M, Anjos RO, Fradico JRB, et al. Acute-Phase Levels of CXCL8 as Risk Factor for Chronic Arthralgia Following Chikungunya Virus Infection. *Front Immunol*. 2021;12:744183. Epub 2021/10/19.
104. Maramattom BV, Syed AA. Viral neuromyopathy associated with acute hepatitis B infection. *BMJ Case Reports*. 2022;15(1):e247203.
105. Wimalasiri-Yapa B, Yapa HE, Huang X, Hafner LM, Kenna TJ, Frentiu FD. Zika Virus and Arthritis/Arthralgia: A Systematic Review and Meta-Analysis. *Viruses*. 2020 Oct 7;12(10). Epub 2020/10/11.