

Psoriasis and COVID 19: A narrative review with treatment considerations

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Abstract

COVID-19 is a highly contagious respiratory infection caused by severe acute respiratory syndrome coronavirus 2. COVID-19 outbreak, has been declared a pandemic by the World Health Organization on March, 2020. The pandemic has affected the management of psoriasis, not only for those who are under treatment but also for those who are about to begin a new therapy to control their disease. An increasing number of studies in the current literature have focused on the relationship between psoriasis and COVID 19 from different perspectives. This narrative review includes searching the PubMed and Web of Science databases using the keywords "psoriasis," "psoriatic arthritis", "coronavirus", "COVID 19" and "SARS-Cov-2". The search was supplemented by manual searching of reference lists of included articles. A total of 11 relevant original investigations and 6 case studies was identified. The search was updated in May 2019. Due to the absence of randomized controlled trials, it is not likely to have a robust evidence-based approach to psoriasis management in the era of COVID-19. However, current literature may provide some clues for safety considerations. Conventional immunosuppressive therapies such as methotrexate and cyclosporine, and anti TNF agents should not be preferred due to increased risk of infection, especially in high-risk areas. The use of cyclosporine may pose additional risk due to the side effect of hypertension, which has been reported to be associated with susceptibility to severe COVID-19. Considering that current literature has provide no conclusive evidence that biologics increase the risk of COVID-19,

withdrawal of these agents should be reserved for patients with COVID 19 symptoms. The treatment approach should be personalized, considering the advantages and disadvantages for each case separately.

Keywords: COVID-19, coronavirus, pandemic, psoriasis, psoriatic arthritis

Introduction

Psoriasis is a common chronic inflammatory skin disease associated with significant morbidity extending beyond the cutaneous manifestations ¹. The disease affects about 2-3% of the population worldwide, and its' management requires qualified professionals to provide high-quality care.^{2,3} COVID-19 is a highly contagious respiratory infection caused by severe acute respiratory syndrome coronavirus 2. COVID-19 outbreak, which caused thousands of deaths, has been declared a pandemic by the World Health Organization on March, 2020⁴. The pandemic has been reported to modify the course of many diseases, and psoriasis is not exempt from the impact of the outbreak^{5,6}.

Methods

This narrative review includes searching the PubMed and Web of Science databases using the keywords "psoriasis," "psoriatic arthritis", "coronavirus", "COVID 19" and "SARS-Cov-2". The search was supplemented by manual searching of reference lists of included articles. A total of 11 relevant original articles and 6 case studies was identified. The search was updated May 2019.

The impact of pandemic on the course of psoriasis

The COVID 19 pandemic has altered the approach to all patients necessitating close contact during a visit, including dermatologic consultations. The health care system was overwhelmed in many countries, and many centers couldn't cope with the vast number of patients. Patients with psoriasis were not exempt from this situation and had only limited access to required health care settings in many countries. Many centers were able to maintain scheduled treatments for only selected patients³. Limited availability of dermatology care services caused exacerbation of pre-existing cases of psoriasis, while new cases failed to be diagnosed. "Stay at home" orders issued by many authorities to limit the spread of the infection were another reason for fewer patients applying for outpatient services⁷.

Emotional stress is another factor that may act as a catalyst for the onset and aggravation of psoriasis⁸. Kutlu and Metin suggested that the burden of stress prompted by the COVID-19 pandemic might raise the number of psoriasis cases demanding dermatology visits⁹.

A recent web-based study investigating the association of outdoor activity restriction and income loss with patient-reported outcomes of psoriasis during the COVID-19 pandemic showed that 43.7% of 926 patients described moderate-to-much worsening of psoriasis. Outdoor activity limitation was found to be positively correlated with the worsening of psoriasis, stress, and anxiety and depression. Likewise, income loss was associated with the exacerbation of psoriasis, stress, and anxiety and depression¹⁰.

Maximizing the psycho-social support available to patients with psoriasis during the pandemic may play a significant role in controlling disease activity.

The impact of COVID 19 itself on the course of Psoriasis

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Patients with COVID 19 may show characteristics of hyperinflammation caused by the overproduction of cytokines. Biomarkers of inflammation such as C-reactive protein and ferritin have been found significantly elevated in patients with Covid-19¹¹. Given the crucial role of inflammation in the pathogenesis of psoriasis, it can be suggested that hyperinflammation status caused by COVID-19 may also alter the course of psoriasis. In their series of 52 patients, Kutlu and Metin found that 9.6% of patients with COVID-19 who were previously admitted to the dermatology outpatient clinic had psoriasis. They concluded that patients with psoriasis may be more vulnerable to COVID 19⁹. Ozaras et al reported a case of psoriasis worsened possibly due to COVID 19. The authors implied that hyperinflammation status generated by COVID 19 itself might exacerbate psoriasis.¹²

COVID-19 related medications and psoriasis

At this time there are no medications that have been proven to be effective for the prevention or treatment of COVID-19. However, various antiviral agents, immunotherapies, and vaccines continue to be investigated as potential therapeutics.

Hydroxychloroquine has been licensed since 1955 for the prevention and treatment of malaria¹³. The studies suggest that HCQ may have antiviral effects. Notwithstanding the absence of obvious evidence, Food and Drug Administration (FDA) allowed emergency use of HCQ in hospitalized patients without alternative treatment options¹⁴. Psoriasis has been reported to be induced or aggravated by HCQ. Most recently, Kutlu and Metin reported a 71-year-old patient with COVID-19 to have an aggravation of pre-existing psoriasis following HCQ and oseltamivir administration⁵. Although the precise causes of this effect are not entirely understood, it has been reported that HCQ may increase the production of IL-17 resulting in

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enhanced keratinocyte growth¹⁵. In their recent systematic review investigating the effects of HCQ on psoriasis, Sachdeva et al identified 18 cases of psoriasis affected by HCQ. Of the 18 cases, 50.0% had new-onset psoriasis, 27.8% experienced an aggravation of psoriatic lesions, and 22.2% showed a relapse of psoriasis after HCQ treatment. Besides well-known adverse effects of HCQ, including prolonged QT and cardiomyopathy, it is also crucial to recognize the possible impact of HCQ on worsening, recurrence, or new onset of psoriatic lesions. However, given the absence of clear evidence, more extensive studies are needed to validate the findings reported so far¹⁶.

Azithromycin is a macrolide antimicrobial agent with documented in vitro antiviral and anti-SARSCoV-2 effects. It may modify SARS-CoV-2 entry by interfering between its spike protein and host ACE2 receptor. Clinical studies have revealed the ability of azithromycin to decrease the viral load. It has also been shown to improve mortality in the Middle East respiratory syndrome–coronavirus infection¹⁷.

A single-blind, randomized-controlled study has shown that azithromycine may be a potential therapeutic option for chronic plaque psoriasis via its effects on superantigen producing Group A streptococcus, and by its possible immunomodulatory effect on epidermal langerhans cells and keratinocytes¹⁸. In another study, Huang et al found that azithromycin inhibits TLR7 signaling in dendritic cells and improves the imiquimod-induced Psoriasis-like cutaneous inflammation in mice¹⁹. It can be hypothesized that the use of azithromycin in COVID 19 cases with pre-existing psoriasis may alleviate psoriatic lesions. However, it is obvious that more observations and prospective studies are needed to confirm or reject this hypothesis.

Treatment of psoriasis in the era of COVID 19

Acitretin

Acitretin has anti-inflammatory properties and inhibits cell differentiation without immunosuppressive effects. In their cohort study, Dommasch et al found that patients with psoriasis on acitretin treatment showed no increased risk of viral or respiratory infection²⁰. Caselli et al showed that retinoids may have antiviral effects on human herpesvirus²¹. The effects of retinoids on SARS-Cov-2 remains unknown. Although acitretin has not been proven safe in patients with COVID-19, it can be preferred during the pandemic because it has no immunosuppressive effects.

Methotrexate and Cyclosporin

Both methotrexate and cyclosporine are associated with an increased risk of infection. The overall frequency of contracting pneumonia in patients with psoriasis using methotrexate has been reported to be 0.8%²². Cyclosporine only slightly increases the risk of respiratory tract infections. However, the main adverse effects of cyclosporine, such as hypertension and renal dysfunction may pose more severe risks for patients contracted COVID 19. It should be noted that patients with hypertension are more prone to develop severe COVID 19 infection²³. Unexpectedly, Wilde AH reported that cyclosporine strongly inhibits in-vitro replication of MERS-coronavirus, while its in-vivo effects remain unknown²⁴.

Despite the impact of these immunosuppressive agents on the course of COVID-19 is clearly unknown, several dermatology societies have recommended to withdrawn or suspend immunosuppressive treatments in the case of COVID-19 diagnosis till the patient recovers from the infection. However, the decision has been left to the cooperation between the patient and physician in charge, considering the advantages/disadvantages for each case separately^{25,26}.

Biologics and anti IL therapies

Biologics inhibit immune-mediated pathways including distinct cytokines. Therefore, they may pose a possible risk of enhanced sensitivity to infections. However, there is no clear evidence supporting the withdrawal of biologics for most patients with psoriasis due to the risk of infection. Some authors have not recommended the withdrawal of TNF α inhibitors and anti-IL biologics due to “likely moderate risk” in the case of mild viral symptoms²⁷. Other authors have proposed avoidance of TNF α inhibitors for patients with cutaneous diseases in regions with high infection rates, and discontinuation of all biological agents in the case of exposure to COVID-19 cases²⁸. Nevertheless, whether discontinuation of immunomodulatory treatments may enhance the risk of cytokine storm is remained unknown.

Several studies reported comparable risks of infections in patients with psoriasis receiving biologic agents. In a study investigating the risk of serious infection in patients with psoriasis receiving biologics, the highest risk has been reported for infliximab. The authors found no significant increases in the risk of serious infection for etanercept, adalimumab, or ustekinumab compared with non-biologic systemic therapies or methotrexate-only²⁹. Another study has shown no significant difference between the biologics and other systemic therapies in terms of the risk of serious infection³⁰. In a recent study, including 515 patients with psoriasis on biologics, psoriasis worsened in 9 of the 27 (33.3%) patients who left their treatments. None of the 488 patients who survive treatment described any COVID-19 related symptoms, supporting the safety of biologic agents in patients with psoriasis³¹. In a cross-sectional, questionnaire-based study, the authors found that COVID 19 knowledge prevents biologics discontinuation. The authors concluded that dermatologists should inform their patients about COVID-19 to

avoid their loss of compliance³². In a multicenter study, the authors reported that 23 patients with psoriasis on biologics had COVID-19 symptoms but they did not stop treatment. The authors did not observe a more severe course of suspected COVID-19 signs in patients who maintained treatment³³. In their case series including four COVID 19 patients with psoriasis on biological drugs, the authors found that only one patient, who was on guselkumab, exhibited a severe form of COVID 19. Another patient, who was on IL-12/23 inhibitor ustekinumab, showed only mild symptoms. The other two cases did not show any symptoms. The authors concluded that biological drugs may play a protective function against the onset and the course of the infection³⁴. On the other hand, Benhadeu et al reported improvement of COVID 19 symptoms following guselkumab injection in a patient with psoriasis³⁵. Messina et al also reported a case of COVID 19 in a patient with psoriasis on IL-23 inhibitor guselkumab. The patient showed only mild symptoms and the authors concluded that IL23/IL-17 pathway inhibition may not be deleterious in the setting of COVID-19 infection³⁶. Balestri et al reported a patient who was infected during the induction regimen of IL-17 inhibitor ixekizumab. The patient was tested positive for SARS-CoV-2 following contact with a COVID positive patient. The patient was completely asymptomatic, although he continued the treatment as previously scheduled³⁷. Considering the interference of IL-17/23 pathway may have beneficial outcomes in COVID -19, ixekizumab is being investigated for the treatment of COVID -19 infection³⁶. In a large cohort study including 1193 patients with psoriasis on biologics and small molecules, the authors found that patients on biologics were at greater risk to test positive for COVID-19 and to be hospitalized. However, they reported no increased risk of intensive care unit admission or death³⁸. In a retrospective multicenter study including 206 patients with psoriasis

on biologics, the authors found no significant number of hospitalizations or deaths from COVID-19³⁹. In another retrospective study, including 980 patients with psoriasis on biologics, the authors have found no early signal of an increased hospitalization or death from COVID-19⁴⁰. Finally, in a telephone consultation-based study including 168 patients with psoriasis on biologics, the authors did not observe a high frequency of COVID-19 or related symptoms⁴¹. Current literature has shown no conclusive evidence that biological agents increase the risk of COVID-19. Therefore, preventive withdrawal of treatment should be avoided and reserved for patients with COVID 19 symptoms. The cessation of biologics may also be considered for patients having contact with a confirmed case of COVID-19. Unnecessary biologic withdrawal may cause a worsening of psoriasis, increased disease burden, unfavorable impact on the quality of life, and raised health care costs. Moreover, the subsequent return to biologic therapeutics can be related to switching toward more expensive drugs because of the limited efficiency of biologics in the same patient after their interruption⁴².

Psoriatic arthritis and COVID 19

Psoriasis and psoriatic arthritis (PsA) share many treatments, including methotrexate, biologics, small molecules, and cyclosporine. Valenti et al described a case of psoriasis and PsA managed with adalimumab every two weeks for about two years, that rapidly recovered from COVID-19⁴³. Messina et al reported a case of COVID 19 in a patient with psoriasis and PsA on guselkumab. The patient showed only mild symptoms and the authors suggested that IL23/IL-17 pathway interference may not be harmful in the setting of COVID-19 infection³⁶.

Although there is a slight risk of infections with these therapies, many rheumatologic societies including European League Against Rheumatism, and American College of Rheumatology are

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against the improper withdrawal of immunosuppressants and immunomodulatory therapies for PsA due to the risk of disease flare which may be associated with more adverse events than the treatment itself. Exacerbation of PsA may induce systemic inflammation and immunological disturbance which are responsible for increased sensitivity to infections in the setting of systemic polyarthritis. Moreover, an active disorder requires a medical reassessment, which is best to be avoided during the pandemic due to the higher risk of contamination in the hospital. On the other hand, if any symptoms suggestive of COVID 19 occur, the discontinuation of immunosuppressive and immunomodulatory therapies should be considered on a case by case basis⁴⁴. It should be noted that almost all available data originate from the pre-COVID-19 area and they should be interpreted with caution⁴⁵.

Nonsteroid anti-inflammatory agents are also frequently used in PsA. WHO announced that there is no evidence of any relationship between the use of nonsteroid anti-inflammatory agents and COVID-19 mortality. Until more data is available, nonsteroid anti-inflammatory agents should not be discontinued in patients with PsA⁴⁶.

Conclusions

The COVID 19 pandemic has negatively affected the management of many diseases, and psoriasis is not exempt from this situation. Patients' inability to access adequate health care services and stress burden caused exacerbations in psoriasis cases. We believe that it is essential to closely monitor patients with psoriasis and provide alternative health care tools, such as telephone consultations and teledermatology, when necessary. Providing psycho-social support to the patients and their families may also have beneficial effects in controlling the disease activity. We recommend that classical immunosuppressive agents such as methotrexate,

cyclosporin, and TNF alpha inhibitors should be avoided especially in high-risk areas. Considering that current literature has provide no conclusive evidence that biologics increase the risk of COVID-19, withdrawal of these agents should be reserved for patients with COVID 19 symptoms.

References

1. Kizilyel O, Akdeniz N, Metin MS, Elmas OF. Investigation of oxidant and antioxidant levels in patients with psoriasis. *Turk J Med Sci.* 2019;49(4):1085-1088.
2. Gran F, Kerstan A, Serfling E, Goebeler M, Muhammad K. Current Developments in the Immunology of Psoriasis. *Yale J Biol Med.* 2020;93(1):97-110.
3. Atzori L, Mugheddu C, Addis G, et al. Psoriasis health care in the time of the coronavirus pandemic: insights from dedicated centers in sardinia (Italy). *J Eur Acad Dermatol Venereol.* 2020.
4. 1. int/emergencies/diseases/novel-coronavirus-/technical-guidance/naming-the-coronavirus-disease--and-the-virus-that-causes-it WHOJUhww. Naming the coronavirus disease (covid-19) and the virus that causes it. 2020. 2020. Accessed.
5. Kutlu O, Metin A. A case of exacerbation of psoriasis after oseltamivir and hydroxychloroquine in a patient with COVID-19: Will cases of psoriasis increase after COVID-19 pandemic? *Dermatol Ther.* 2020:e13383.
6. Ye C, Cai S, Shen G, et al. Clinical features of rheumatic patients infected with COVID-19 in Wuhan, China. *Ann Rheum Dis.* 2020.
7. Kutlu O, Gunes R, Coerdts K, Metin A, Khachemoune A. The effect of the "stay-at-home" policy on requests for dermatology outpatient clinic visits after the COVID-19 outbreak. *Dermatol Ther.* 2020.
8. Sathyanarayana Rao TS, Basavaraj KH, Das K. Psychosomatic paradigms in psoriasis: Psoriasis, stress and mental health. *Indian J Psychiatry.* 2013;55(4):313-315.
9. Kutlu O, Metin A. Dermatological diseases presented before COVID-19: Are patients with psoriasis and superficial fungal infections more vulnerable to the COVID-19? *Dermatol Ther.* 2020:e13509.
10. Kuang Y, Shen M, Wang Q, et al. Association of outdoor activity restriction and income loss with patient-reported outcomes of psoriasis during the COVID-19 pandemic: A web-based survey. *J Am Acad Dermatol.* 2020.

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11. Henry BM, de Oliveira MHS, Benoit S, Plebani M, Lippi G. Hematologic, biochemical and immune biomarker abnormalities associated with severe illness and mortality in coronavirus disease 2019 (COVID-19): a meta-analysis. *Clin Chem Lab Med*. 2020.
 12. Ozaras R, Berk A, Ucar DH, Duman H, Kaya F, Mutlu H. Covid-19 and Exacerbation of Psoriasis. *Dermatol Ther*. 2020.
 13. Balak DM, Hajdarbegovic E. Drug-induced psoriasis: clinical perspectives. *Psoriasis (Auckl)*. 2017;7:87-94.
 14. U.S. Food and Drug Administration; 2020 [cited 2020Apr2]. Available from: <https://www.fda.gov/media/136534/download> Accessed.
 15. Said A, Bock S, Lajqi T, Muller G, Weindl G. Chloroquine promotes IL-17 production by CD4+ T cells via p38-dependent IL-23 release by monocyte-derived Langerhans-like cells. *J Immunol*. 2014;193(12):6135-6143.
 16. Sachdeva M, Mufti A, Maliyar K, Lytvyn Y, Yeung J. Hydroxychloroquine effects on psoriasis: a systematic review and a cautionary note for COVID-19 treatment. *J Am Acad Dermatol*. 2020.
 17. Megarbane B, Scherrmann JM. Hydroxychloroquine and Azithromycin to Treat Patients With COVID-19: Both Friends and Foes? *J Clin Pharmacol*. 2020.
 18. Saxena VN, Dogra J. Long-term oral azithromycin in chronic plaque psoriasis: a controlled trial. *Eur J Dermatol*. 2010;20(3):329-333.
 19. Huang SW, Chen YJ, Wang ST, et al. Azithromycin impairs TLR7 signaling in dendritic cells and improves the severity of imiquimod-induced psoriasis-like skin inflammation in mice. *J Dermatol Sci*. 2016;84(1):59-70.
 20. Dommasch ED, Kim SC, Lee MP, Gagne JJ. Risk of Serious Infection in Patients Receiving Systemic Medications for the Treatment of Psoriasis. *JAMA Dermatol*. 2019.
 21. Caselli E, Galvan M, Santoni F, et al. Retinoic acid analogues inhibit human herpesvirus 8 replication. *Antivir Ther*. 2008;13(2):199-209.
 22. West J, Ogston S, Foerster J. Safety and Efficacy of Methotrexate in Psoriasis: A Meta-Analysis of Published Trials. *PLoS One*. 2016;11(5):e0153740.
 23. Karadag AS, Aslan Kayiran M, Lotti T, Wollina U. Immunosuppressive and immunomodulator therapy for rare or uncommon skin disorders in pandemic days. *Dermatol Ther*. 2020:e13686.
 24. de Wilde AH, Raj VS, Oudshoorn D, et al. MERS-coronavirus replication induces severe in vitro cytopathology and is strongly inhibited by cyclosporin A or interferon-alpha treatment. *J Gen Virol*. 2013;94(Pt 8):1749-1760.
 25. American Academy of Dermatology Association. Managing your practice through the COVID-19 outbreak. <https://www.aad.org/member/practice/managing/coronavirus>. Accessed 27 May 2020. Accessed.
 26. International Psoriasis Council. Statement on the coronavirus (COVID-19) outbreak. <https://www.psoriasisCouncil.org/blog/Statement-on-COVID-19-and-Psoriasis.htm>. Accessed 27 May 2020. Accessed.

27. Price KN, Frew JW, Hsiao JL, Shi VY. COVID-19 and immunomodulator/immunosuppressant use in dermatology. *J Am Acad Dermatol*. 2020;82(5):e173-e175.
28. Conforti C, Giuffrida R, Dianzani C, Di Meo N, Zalaudek I. COVID-19 and psoriasis: Is it time to limit treatment with immunosuppressants? A call for action. *Dermatol Ther*. 2020:e13298.
29. Yiu ZZN, Smith CH, Ashcroft DM, et al. Risk of Serious Infection in Patients with Psoriasis Receiving Biologic Therapies: A Prospective Cohort Study from the British Association of Dermatologists Biologic Interventions Register (BADBIR). *J Invest Dermatol*. 2018;138(3):534-541.
30. Kalb RE, Fiorentino DF, Lebwohl MG, et al. Risk of Serious Infection With Biologic and Systemic Treatment of Psoriasis: Results From the Psoriasis Longitudinal Assessment and Registry (PSOLAR). *JAMA Dermatol*. 2015;151(9):961-969.
31. Burlando M, Carmisciano L, Cozzani E, Parodi A. A survey of psoriasis patients on biologics during COVID-19: a single centre experience. *J Dermatolog Treat*. 2020:1.
32. Bragazzi NL, Ricco M, Pacifico A, et al. COVID-19 knowledge prevents biologics discontinuation: data from an Italian multi-center survey during RED-ZONE declaration. *Dermatol Ther*. 2020:e13508.
33. Carugno A, Gambini DM, Raponi F, et al. COVID-19 and biologics for psoriasis: a high-epidemic area experience - Bergamo, Lombardy, Italy. *J Am Acad Dermatol*. 2020.
34. Conti A, Lasagni C, Bigi L, Pellacani G. Evolution of COVID-19 infection in 4 psoriatic patients treated with biological drugs. *J Eur Acad Dermatol Venereol*. 2020.
35. Benhadou F, Del Marmol V. Improvement of SARS-CoV2 symptoms following Guselkumab injection in a psoriatic patient. *J Eur Acad Dermatol Venereol*. 2020.
36. Messina F, Piaserico S. SARS-CoV-2 infection in a psoriatic patient treated with IL-23 inhibitor. *J Eur Acad Dermatol Venereol*. 2020.
37. Balestri R, Rech G, Girardelli CR. SARS-CoV-2 infection in a psoriatic patient treated with IL-17 inhibitor. *J Eur Acad Dermatol Venereol*. 2020.
38. Damiani G, Pacifico A, Bragazzi NL, Malagoli P. Biologics increase the risk of SARS-CoV-2 infection and hospitalization, but not ICU admission and death: Real-life data from a large cohort during red-zone declaration. *Dermatol Ther*. 2020:e13475.
39. Gisondi P, Facheris P, Dapavo P, et al. The impact of COVID-19 pandemic on patients with chronic plaque psoriasis being treated with biologic therapy: the Northern Italy experience. *Br J Dermatol*. 2020.
40. Gisondi P, Zaza G, Del Giglio M, Rossi M, Iacono V, Girolomoni G. Risk of hospitalization and death from COVID-19 infection in patients with chronic plaque psoriasis receiving a biologic treatment and renal transplant recipients in maintenance immunosuppressive treatment. *J Am Acad Dermatol*. 2020.
41. Megna M, Ruggiero A, Marasca C, Fabbrocini G. Biologics for psoriasis patients in the COVID-19 era: more evidence, less fears. *J Dermatolog Treat*. 2020;31(4):328-329.
42. Megna M, Napolitano M, Patruno C, Fabbrocini G. Biologics for psoriasis in COVID-19 era: what do we know? *Dermatol Ther*. 2020:e13467.

43. Valenti M, Facheris P, Pavia G, et al. Non-complicated evolution of COVID-19 infection in a patient with psoriasis and psoriatic arthritis during treatment with adalimumab. *Dermatol Ther.* 2020.
44. Coletto LA, Favalli EG, Caporali R. Psoriasis and psoriatic arthritis: How to manage immunosuppressants in COVID-19 days. *Dermatol Ther.* 2020:e13415.
45. Wollina U, Fioranelli M, Goldust M, Lotti T. Psoriatic Arthritis and COVID-19 Pandemic: Consequences in Medical Treatment? *Dermatol Ther.* 2020:e13743.
46. Giollo A, Adami G, Gatti D, Idolazzi L, Rossini M. Coronavirus disease 19 (Covid-19) and non-steroidal anti-inflammatory drugs (NSAID). *Ann Rheum Dis.* 2020.