Erythrodermic flare-up of psoriasis with COVID-19 infection: A report of two cases and a comprehensive review of literature focusing on the mutual effect of psoriasis and COVID-19 on each other along with the special challenges of the pandemic

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Abstract
The COVID-19 pandemic has been extra challenging for patients with chronic diseases. Psoriasis is one of the chronic conditions that its treatment mostly relies on immuno-suppressants. In this study, we report two cases with a long history of psoriasis that COVID-19 infection caused them to undergo erythrodermic psoriasis.

KEYWORDS
aggravation, biologics, case reports, corona virus, COVID-19, disease course, erythroderma, erythrodermic psoriasis, flare-up, immunomodulator, immunosuppressant, management, psoriasis, review, SARS-CoV-2, treatment

1 | INTRODUCTION

Since the emergence of the novel COVID-19 virus, chronic health conditions have been vastly impacted either directly through the infection and the immune responses followed by it or indirectly by imposing fear on some patients and causing them to restrict or delay their routine follow-up cares, which might aggravate their condition.1,2 Erythrodermic psoriasis is a severe and scarce form of psoriasis vulgaris that affects the entire body and provokes systemic inflammation with unknown certain etiology in which interleukin-4, interleukin-13, and TNF alpha have been suggested to have prominent roles.3 Here, we present two cases of psoriatic patients that developed...
symptoms of erythrodermic psoriasis after affliction with COVID-19.

2 | CASE PRESENTATION

2.1 | Case 1

A 50-year-old male with a 20-year history of psoriasis vulgaris was presented with erythrodermic psoriasis to the emergency department of our hospital. He was a retired employee, and his BMI was 28.68, had no other underlying health condition, and had been a cigarette smoker for 21 years (42 pack-years) but had quit smoking 8 years ago and mentioned occasional consumption of alcohol. One month prior to the admission, he had been in close contact with a COVID-19-positive patient and developed fever and chills, fatigue, and myalgia shortly after. Real-time PCR test was not carried out on, but in the chest CT scan, the typical signs of COVID-19 infection were evident. He had quarantined himself at home for 2 weeks and began taking Naproxen 250 mg tablet (three times a day), Hydroxychloroquine 500 mg tablet (twice a day), and N-acetyl cysteine effervescent (daily) for 5 days and then without consulting a doctor added Amoxicillin 500 mg (three times a day) and Azithromycin 250 mg (daily) to his regimen. He had also delayed receiving Adalimumab due to his COVID-19 infection. The patient stated that 2 days after taking the antibiotics, he developed general erythema and pruritus scaling that started from his palms and the soles of his feet with severe paresthesia. The physical examination revealed fever, weakness, and facial...
edematous accompanied by generalized skin redness and desquamation. (Figures 1 and 2) No signs of tachycardia, mucosal involvement, or swollen ankles were detected, and the rest of his examination was unremarkable. He had been a known case of psoriasis for about 20 years, he had been receiving Infliximab until 4 years ago, and his condition had been under control but after Infliximab was no longer covered by insurance, his medication was switched to Adalimumab, which relatively controlled his condition with occasional mild flare-ups. The patient started receiving Methotrexate 10 years ago, but 6 months ago, it was discontinued due to hepatic cirrhosis. Due to his COVID-19 infection, he had skipped one session of his Adalimumab therapy, which might have been a reason to this sudden flare-up. Laboratory evaluation was significant for high lactic acid dehydrogenase (LDH = 549, normal range 140–280 U/L), and the rest of his laboratory results were within normal range Table 1.

Based on his clinical evaluation, the clinical diagnosis of severe erythrodermic psoriasis was made for him. After
TABLE 1 Comprehensive review of literatures focusing on mutual effect of psoriasis and COVID-19 on each other

| Ref | Case characteristics | Drug history for psoriasis | Psoriasis condition | COVID−19 clinical features |
|-----|----------------------|----------------------------|---------------------|---------------------------|
| 41  | A 55-year-old male   | Conventional drugs + adalimumab switched to ixekizumab | Controlled psoriasis for 4 years + a recent flare-up | Asymptomatic outpatient with positive PCR |
| 5   | A 40-year-old female | Systematic methotrexate and cyclosporine, then switched to Guselkumab for last 2 years | Controlled psoriasis since 2000 | Severe cough, myalgia, fatigue, fever (39.4°C) |
| 9   | An individual in their 30s | Adalimumab for the last 6 months | Controlled psoriasis since childhood with widespread plaque | Symptomatic Outpatient with positive PCR, sore throat, fever (to 101.5 F), mild dry, cough, nonspecific gastrointestinal upset |
| 9   | An individual in their 40s | Ustekinumab for 3 years | Uncontrolled psoriasis for over 20 years with generalized plaque | Symptomatic outpatient with positive PCR, fever (100.8 F), fatigue, shortness of breath, mild nausea |
| 42  | A 62-year-old male   | Guselkumab for past 2 years | Controlled psoriasis | Severe acute respiratory syndrome |
| 42  | A 66-year-old male   | Ustekinumab since 2010 | Not mentioned | Symptomatic outpatient with asthenia, anosmia, ageusia |
| 42  | A 67-year-old female | Adalimumab since 2019 | Not mentioned | Asymptomatic outpatient, quarantined for 15 days after contacting family members diagnosed with COVID−19 |
| 42  | A 66-year-old male   | Secukinumab since 2018 | Not mentioned | Asymptomatic outpatient, quarantined after continuous contact with his wife mild diagnosed with covid−19 |
| 44  | A 46-year-old male   | Ustekinumab recently switched to ixekizumab | Moderate–severe chronic plaque psoriasis | Fever, malaise, dyspnea, chest pain, bilateral interstitial pneumonia |
| Other comorbidities                               | COVID−19 progression                                      | Psoriasis changes during the infection | COVID−19 treatment              | Psoriasis drug adjustment                      | Recommendations                                                                 |
|--------------------------------------------------|-----------------------------------------------------------|----------------------------------------|----------------------------------|-----------------------------------------------|--------------------------------------------------------------------------------|
| Not mentioned                                    | Stayed asymptomatic                                       | No change in psoriatic features        | Supportive therapy, home rest      | Continued biological therapy as formerly prescribed | Biological therapy had positively affected the primary phase of infection       |
| Ehlers−Danlos syndrome                           | Rapid worsening of symptoms, but sudden improvement after the Guselkumab injection | Not mentioned                          | Supportive therapy, home rest      | Continued biological therapy as formerly prescribed | Biologic therapy tapered down the immune reaction                             |
| Sleep apnea, chronic nerve pain                   | Week 1: recovering well                                   | Not mentioned                          | Supportive therapy, home rest      | Held biological therapy until being symptom free for 1 month | Patients on biologic therapies had successfully recovering of COVID−19 infection |
|                                                  | Week 2: mild shortness of breath, respiratory discomfort, fatigue, and diaphoresis |                                      |                                  |                                               |                                                                                |
|                                                  | Week 3: at the end of 3rd week became symptom-free       | (Continues)                            |                                  |                                               |                                                                                |
| Not mentioned                                    | Gradually recovered and was symptom free in 9 days       | Not mentioned                          | Supportive therapy, home rest      | Held biological therapy until being symptom free for 1 month | Not mentioned                                                                 |
| HTN, DM, chronic renal failure and overweight (BMI: 29) | Hospitalization for 1 month (ICU admission for 2 weeks) then discharged symptom free | Not mentioned                          | Hospitalization and intensive care | Held biological therapy | Not mentioned                                                                 |
| HTN, dyslipidemia and previous Myocardial infarction | Symptom free after 1 month                                | Maintenance of the remission of psoriasis | No pharmacological treatment      | The biologic therapy was interrupted only during the quarantine period, without worsening of psoriasis | Not mentioned                                                                 |
| HTN, metabolic syndrome                          | Stayed asymptomatic                                       | No change in psoriatic features        | Supportive therapy, home rest      | Continued biological therapy as formerly prescribed | Not mentioned                                                                 |
| HTN, diabetes mellitus, metabolic syndrome, and obesity (BMI: 32) | Stayed asymptomatic                                       | No change in psoriatic features        | Supportive therapy, home rest      | Continued biological therapy as formerly prescribed | Not mentioned                                                                 |
| Type I Brugada syndrome, arterial HTN            | Hospitalized for 22 days, symptom free after 1 month     | Not mentioned                          | Hydroxychloroquine, ceftriaxone noninvasive continuous positive airway pressure (CPAP) | Not mentioned                      | Not mentioned                                                                 |
|                                                  |                                                          | (Continues)                            |                                  |                                               |                                                                                |
| Ref | Case characteristics | Drug history for psoriasis | Psoriasis condition | COVID−19 clinical features |
|-----|----------------------|-----------------------------|---------------------|-----------------------------|
| 43  | A 73-year-old female | Secukinumab for about 1 year | Chronic plaque psoriasis associated with arthritis (and episodes of dactylitis) | Fever, sore throat, mild dry cough |
| 45  | A 55-year-old female | Apremilast therapy for the last 6 months | Palmoplantar psoriasis | Bilateral pneumonia |
| 45  | A 42-year-old male | Apremilast | Psoriasis and psoriatic arthritis | Not mentioned |
| 45  | A 55-year-old male | Methotrexate, infliximab, switched to a premlast due to recurrent infections and cyclic neutropenia | Plaque and nail psoriasis and psoriatic arthritis | Not mentioned |
| 45  | A 48-year-old female | Secukinumab | Not mentioned | Had the COVID−19 infection criteria (not mentioned in details) |
| 45  | A 56-year-old male | Infliximab every 6 weeks | Controlled psoriatic arthritis | Bilateral pneumonia, acute respiratory distress |
| 45  | A 52-year-old female | Adalimumab therapy failed, then infliximab for the last 3 years | Peripheral spondylarthritis | Moderate inflammatory symptoms |
| 46  | A 73-year-old male | Cyclosporine, methotrexate | Uncontrolled psoriasis with severe flare-ups (manifesting as diffuse erythematous, scaly plaques progressing to erythroderma) | Intermittent fever, malaise, dry cough |

**TABLE 1** (Continued)
| Other comorbidities | COVID−19 progression | Psoriasis changes during the infection | COVID−19 treatment | Psoriasis drug adjustment | Recommendations |
|---------------------|----------------------|--------------------------------------|--------------------|--------------------------|-----------------|
| Hypertension        | Symptomatic outpatient | Not mentioned                        | Hydroxychloroquine | Administered biological therapy during and shortly after the infection | A successful immune response can occur in the presence of IL−17 inhibition |
| Not mentioned       | Severe inpatient, Recovered after 1 month | Not mentioned                        | Not mentioned      | Maintained Apremilast during the Hospitalization |                |
| Not mentioned       | Quarantined after continuous contact with his wife with moderate COVID−19 symptoms, after quarantine period, showed no respiratory affections | Not mentioned | Not mentioned | Maintained Apremilast during the confinement |                |
| Hairy cells leukemia | ICU admission with multiple complications such as bacteremia, kidney deterioration, digestive hemorrhages | Not mentioned | Not mentioned | Apremilast was withdrawn in the ICU, topical treatment for psoriasis lesions |                |
| Not mentioned       | Outpatient, self-confined at home | Not mentioned                        | Not mentioned      | Stop receiving secukinumab dose during confinement |                |
| Not mentioned       | ICU admission for 15 days | Not mentioned                        | Not mentioned      | Not mentioned            | Apremilast can be considered a safe alternative for both infected and uninfected COVID−19 patients |
| Not mentioned       | Symptomatic outpatient that persistency of COVID−19 symptoms forces her to attend the emergency unit on several occasions, until disease recovery | Not mentioned | Not mentioned | Held infliximab |                |
| Not mentioned       | Symptomatic outpatient, Symptoms resolved in 1 week with home rest | Experienced severe psoriasis flare-ups after the discontinuation of psoriasis treatment during disease course but gradually skin lesions were improved | Hydroxychloroquine, lopinavir/ritonavir combination | Cyclosporine, methotrexate were ceased, Cyclosporine continued 2 weeks after COVID−19 improvement |                |

(Continues)
| Case characteristics | Drug history for psoriasis | Psoriasis condition | COVID−19 clinical features |
|----------------------|----------------------------|---------------------|---------------------------|
| Ref  1  | 26 psoriatic patients, mean age of 63.5, 15 male/11 female | Treated with biologics such as Anti TNFa, Anti IL−17, Anti-IL 12/23, Anti IL−23 | Diagnosed with moderate-to-severe chronic plaque psoriasis, 8 (31%) of them had joint involvement | Fever (62%), anosmia/Ageusia (27%), cough (19%), dyspnea (8%) Pneumonia (27%), gastrointestinal disorder (11%), other (11%) |
| Ref  3  | • 83-year-old male • 77-year-old male | • Under treatment with TNF-α inhibitors • Under treatment with IL-12/23 inhibitors | Chronic plaque psoriasis | NM |
| Ref  51 | 77-year-old male | Several conventional and biologic drugs, including cyclosporine, methotrexate, infliximab, ustekinumab and secukinumab, and he switched to risankizumab for last 8 months | Chronic plaque psoriasis for 18 years | 39°C fever, productive cough with dyspnea, diarrhea, nausea and vomiting |

**New onset of psoriasis in COVID−19 patients**

| A male in his 30 s | Not mentioned | Experiencing pain at the right elbow, together with the appearance of 3 itchy, demarcated erythematous scaly patches on the extensor surface of both elbows and groin | Arthromyalgia, fatigue, diarrhea, anosmia |
| 62-year-old female | History of 3 years of metoprolol, apixaban, beclomethasone, albuterol inhalers, vitamin B12, folate | New onset of palmoplantar pustules, palmar erythema with hyperkeratosis and desquamation, pink papulopustular lesions on the extremities, and psoriasiform plaques of the trunk and scalp | Fatigue, cough, shortness of breath, night sweats, chills, myalgias |
| Other comorbidities | COVID−19 progression | Psoriasis changes during the infection | COVID−19 treatment | Psoriasis drug adjustment | Recommendations |
|---------------------|----------------------|----------------------------------------|--------------------|--------------------------|-----------------|
| Hypertension, other cardiovascular diseases, dyslipidemia, obesity, diabetes, and COPD | 42% of patients hospitalized, 73% recovered, 12% sequelae, 23% unknown/pending | Not mentioned | Not mentioned | 76% discontinued biologic therapy, and in 27% of patient's biologic therapy were restarted | Findings suggest that the use of biologics is not associated with higher risk of SARS-COV2 infection or with worse COVID−19 outcome. |
| Rheumatoid arthritis, hypertension, acute myocardial infarction 20 years ago, and chronic obstructive pulmonary disease (COPD) for 15 years. A heavy smoker with tobacco consumption | Both of these patients died because of acute respiratory distress syndrome | NM | NM | NM | |
| 2 weeks history of painful limitation of the right elbow | Symptomatic outpatient | After 10 days of onset of COVID−19 symptoms skin lesions appeared, then skin and joint symptoms had completely disappeared after 6 weeks | Self-isolated and self-medicated with symptomatic drugs | | |
| Obesity, asthma, DM, HTN, and atrial fibrillation, 23-pack-year history of cigarette smoking (quit 1994) Notable Family history of psoriasis in her aunt and cousin | Not mentioned | Blisters on the palms, pruritic rash continued to spread to involve the forearms, trunk, scalp after 2 weeks resolution of COVID−19 symptoms | Not mentioned | | |

Findings suggest that the use of biologics is not associated with higher risk of SARS-COV2 infection or with worse COVID−19 outcome.
TABLE 1 (Continued)

| Ref | Case characteristics | Drug history for psoriasis | Psoriasis condition | COVID–19 clinical features |
|-----|----------------------|---------------------------|---------------------|---------------------------|
| 47  | A 38-year-old male   | Not mentioned             | Chronic single active plaque psoriasis affecting the lateral aspect of the right ankle | Fever, dry cough          |
| 48  | A 45-year-old male   | Methotrexate on and off since 4 years ago, cyclosporine, acitretin | 20-year history of psoriasis with severe erythroderma, ectropion, Severe onycholysis | Fever (Spike pattern 40–40.5°C) |
| 51  | A 12-year-old male   | NM                        | Diagnosed with plaque psoriasis when he was 5 years old and has been in remission for about 7 years. | High fever, cough         |

Abbreviations: BMI, body mass index; DM, diabetes mellitus; HCQ, hydroxychloroquine; HTN, hypertension; ICU, intensive care unit; IL, interleukin; MTX, methotrexate; PCR, polymerase chain reaction; TNF alpha, tumor necrosis factor-alpha.

initial managements of his condition, he was treated with Cyclosporine 10 mg tablet (three times a day), Prednisone 50 mg tablet (daily), Neostigmine 25 mg capsule (twice a day), Acyclovir 80 mg tablet (three times a day), topical ointment of Mometasone (twice a day), and a mixed lotion of Eucerin and fluticasone (twice a day) on his lesions. He was discharged in a good condition and symptom free. Up to the time of this report, he has not experienced any psoriasis flare-ups or hospitalization.

2.2 | Case 2

A 57-year-old female with a history of diabetes, hepatic cirrhosis, and psoriasis (for 15 years) was admitted to the internal medicine ward of our hospital with generalized edema and ascites along with general erythrodermic psoriasis lesions on her trunk, face, upper, and lower limbs (Figure 3). She was isolated from other patients because despite her nontypical symptoms, she was suspected to be infected with COVID-19.

We visited the patient for dermatology consultation. She was a housewife, and her BMI was 27.18. For diabetes, she had been receiving insulin, and for psoriasis, she had been receiving MTX for more than 10 years until being diagnosed with hepatic cirrhosis a few months ago. She had not been receiving any other substitutes for psoriasis ever since. She mentioned no history of smoking or alcohol consumption. The infectious disease department consulted us to refrain from administering Adalimumab or any other immunosuppressant. Therefore, we tried to manage her lesions with topical agents (including Betamethasone and Vaseline ointment and Clobetasol lotion). A PCR test was obtained from her and confirmed her COVID-19 infection, and she started receiving the routine COVID-19 treatment according to national guidelines at the time. Unfortunately, her COVID-19 condition was rapidly deteriorated and she was admitted to the intensive
care unit and she expired. Table 1 shows the summarized results for the cases presented in the literature focusing on mutual effect of psoriasis and COVID-19 on each other.

3 | METHOD

We searched Medline database using the following key-boards: “corona virus,” “COVID-19,” “SARS-Cov-2,” “psoriasis,” “erythrodermic psoriasis,” and “psoriasis arthritis” and chose 13 relevant case reports and 6 relevant original articles.

4 | DISCUSSION

Psoriatic patients mostly rely on immunomodulators. Among immunomodulators, biologics that function through TNF alpha, IL-23, or IL-17 inhibition are considered to be the most effective agents in the management of psoriasis. With the COVID-19 outbreak, treatments that require immunosuppression or immunomodulation have remained a challenging subject. Although some studies are concerned about the viral replication phase of COVID-19 infection in patients receiving immunosuppressants, there are other studies that find immunosuppressants beneficial in preventing drastic immune responses when psoriatic patients are afflicted with COVID-19.

A lot of studies indicate that the use of biologics does not inflict any further risks compared to the general population and several studies have reported full recovery from COVID-19 infection in patients receiving biologics. For instance, recently Talamonti et al. published an observational study that included 12,807 patients with moderate-to-severe chronic plaque psoriasis treated with biologic agents. Their findings revealed an almost similar incidence rate of mild COVID-19 among patients in comparison with the general population, which question the association of treatment with biologic agents with a poor
outcome or higher susceptibility to COVID-19 infection in psoriatic patients. Consistent with Talamonti findings, certain studies like Brownstone et al. and Messina et al. not only have reported successful recovery in biologic receiving patients but also suggest that biologics could be considered as potential life savers against COVID-19 induced cytokine storm.

Another type of immunosuppressants that are regularly prescribed for psoriasis is nonbiologics, which include methotrexate (MTX) and cyclosporine. Existing studies advice against the use of these agents for it, which has been demonstrated that MTX is accompanied with up to 45% increased risk of COVID-19 infection. On the contrary, some studies find the anti-inflammatory effects of MTX desirable in the inflammatory phase of COVID-19 infection.

A case report has looked into 4 cases that were in close contact and 3 out of 4 of them were infected with COVID-19 but the fourth one that was under treatment with MTX because of psoriasis did not become infected.

Although cyclosporine has been reported to be safer than MTX in the course of COVID-19 infection but still a number of studies suggest abstain from it. Another challenging aspect of this matter is that COVID-19 infection itself provokes immune responses that can be progressed to cytokine storm resulting in a hyperinflammation state in the body that attributes to the pathogenesis of psoriasis, which similarly causes hyper-inflammation. This immense cytokine release might exacerbate psoriatic patients' condition as it has been reported by different studies. We have discussed in our previous studies about the potential association between COVID-19 and dermatology conditions.

Using glucocorticoids is one of the main therapeutic strategies in patients with severe COVID-19 symptoms; in psoriatic patients, the administration of glucocorticoids during the course of COVID-19 infection might affect the patient’s psoriasis presentation, as in some cases early after the administration of steroids, psoriatic lesions seem to be mitigated, and after finishing the course of treatment, some patients have reported to experience certain degrees of psoriasis flare-up.

Currently, there is no general consensus about the medications used in COVID-19 treatment but from the beginning of the pandemic Hydroxychloroquine (HCQ) has been one of the most common choices in COVID-19 treatment. Certain case reports have suggested HCQ to have worsening effects on the course of psoriasis. Although the exact cause of this effect is not entirely clear, some studies attribute this to an elevation of IL-17 in patients taking HCQ.

Sachdeva et al. have reported 9 cases with a new onset of psoriasis after taking HCQ. Although they hold HCQ responsible for this, a handful of case reports exist on the topic of new psoriasis onsets after COVID-19 infection, which conclude these new onsets to be the result of the infection itself. Lehmann et al. have even reported a case with a new onset of psoriasis after COVID-19 vaccination.

Another commonly used medication in COVID-19 is azithromycin. Although the benefits of this macrolide in COVID-19 treatment have remained controversial, it is considered to have a potential immunomodulatory effect on kerocytes and epidermal Langer Hans cells, which could be helpful in the improvement of psoriatic legions. But data on this matter are very limited and further investigation is crucial.

As it was mentioned, our first case had consumed amoxicillin as well. Although there is existing evidence about the association between consumption of some antibiotics like tetracycline and psoriasis aggravation, flare-ups following derivatives of penicillin administration have been reported to be extremely rare. Therefore, we assume that amoxicillin may not have been very likely to be the culprit that caused the exacerbation.

Both of our cases had stopped their immune suppressants before being infected with COVID-19, and they both had consumed HCQ. Although the main cause of their flare-up is not entirely clear but according to previous studies, we can assume that stopping their immunosuppressive therapies without consulting their doctors might have made them more susceptible to the COVID-19-related cytokine storm; moreover, the use of HCQ might have aggravated their underlying psoriasis.

With the combination of limited access to their medications due to the COVID-19 outbreak, inflammation caused by COVID-19 infection and the adverse effects of the medications currently in use for opposing COVID-19 infection, adding to it the stress that the COVID-19 causes (which is considered another factor in psoriasis aggravation), chronic disease patients, and their doctors are faced with a dilemma for finding a sweet spot of managing their patients' underlying psoriasis condition and overcoming the infection caused by COVID-19.

Overall, evidence suggests that discontinuing the immunosuppressive therapies in patients who had been using them before being infected with COVID-19 is not advisable, while more evidence points to biologics being safe but even nonbiologics that are controversial for their safety are recommended to be continued with caution.

To have a better understanding of the clinical aspects and managements of psoriasis in the COVID-19 pandemic, we have reviewed and summarized reported cases of psoriasis patients diagnosed with COVID-19 and cases...
with new onset of psoriasis in COVID-19 cases. We categorized case reports into three main groups.

### 4.1 COVID-19 infection in known psoriasis patients without specific changes in psoriatic symptoms

A number of studies have reported an asymptomatic course of COVID-19 infection in psoriatic patients that were on biologic treatment without any changes in their psoriasis condition. Balestri et al. and Conti et al. have reported patients that were unaware of their COVID-19 infection until their close family members were tested positive and they remained symptom free in the whole duration of their COVID-19 infection.\(^41,42\) Benhadou et al reported a 40-year-old woman with mild COVID-19 symptoms that were worsening whereat she received her scheduled Guselkumab and her respiratory symptoms were instantly mitigated.\(^5\) There were also other cases including the cases reported by Brownstone et al. and Galluzzo et al. and 2 of the cases reported by Conti et al. that developed mild COVID-19 symptoms and recovered without being hospitalized.\(^9,42,43\) In some cases, the course of COVID-19 was more challenging; for example, in one of the cases reported by Conti et al. the patient was admitted to intensive care unit (ICU), but fortunately he also successfully recovered from the infection. ICU admission was reported by Queiro et al. as well. Facheris et al. also reported a 22-day hospitalization in a 46-year-old male.\(^44,45\) The aforesaid cases were all receiving biologics, and no alteration in the course of their psoriasis was reported. Nasiri et al. reported a patient under treatment with MTX and cyclosporine with uncontrolled psoriasis and intermittent severe flare-ups that also recovered without being hospitalized.\(^46\) However, his psoriatic legions were worsened at first because he had discontinued his immunosuppressive medications, but then his legions gradually improved.

### 4.2 COVID-19 infection in known psoriasis patients with specific changes in psoriatic symptoms

Gananandan et al. reported a 38-year-old male with chronic active psoriatic plaques that 6 days after the onset of fever caused by COVID-19 developed multiple erythematous legions on his lower limbs.\(^47\)

In Ghalamkarpour’s paper, a 45-year-old male with a 20-year history of psoriasis had erythrodermic flare-up following COVID-19 infection. Moreover, the patient had discontinued his psoriasis medications before being infected with COVID-19.\(^48\)

### 4.3 New onset of psoriasis in COVID-19 patients

De Stefano et al. reported a male in his thirties without any previous history of psoriasis that was infected with COVID-19 with mild symptoms, but 10 days after recovery from COVID-19, psoriatic legions started appearing from his groin and the extensor surface of his elbows.\(^49\)

Another similar case was a 62-year-old female reported by Mathieu et al. that developed psoriatic legions 2 weeks after COVID-19 recovery.\(^50\) Another remarkable case was reported Lehmann et al. describing a new onset of guttate psoriasis after COVID vaccination.\(^37\)

### 5 Conclusion

Although the main reason for their flare-up in not entirely clear in the two cases that we reported but we assume that discontinuation of psoriasis systemic treatment and not receiving any immunosuppressant had made them more susceptible to the COVID-19-related cytokine storm and disease flare-up. Our literature review revealed that COVID-19 in psoriatic patients is not accompanied with any further morbidity and mortality compared to the general population. Patients that had discontinued their psoriasis medications were more likely to experience psoriasis flare-ups, but patients that maintained their routine medications were less likely to experience any alterations in their underlying psoriasis. A considerable number of studies suggest that biologics seemed to have helped psoriatic patients mitigate their COVID-19 symptoms and accelerated their recovery from COVID-19. Some studies suggest that taking HCQ might aggravate the underlying psoriasis condition.

Most flare-up cases were in patients that were not receiving biologics and had discontinued their nonbiologic immunosuppressive medications, whether this has been due to the COVID-19-related cytokine storm or the medications given to them for COVID-19 is not clear but when the underlying psoriasis is neglected, COVID-19 is more likely to trigger flare-up.

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CONFLICT OF INTEREST
The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

AUTHOR CONTRIBUTION
EB, ASB, and AG performed the research; EB and ASB designed the study. MHFK contributed essential reagents or tools; NS, ZS, MHFK, and AG searched the literature. NS, ZS, and ASB wrote the paper; all authors contributed in revising the paper critically for important intellectual content; EB, ASB, and AG wrote the paper; and all authors have read and approved the final manuscript.

CONSENT
Written informed consent was obtained from the patients to publish this report.

DATA AVAILABILITY STATEMENT
Data are available on reasonable request from the corresponding author.

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