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ORIGINAL ARTICLE

Impact of the first wave of the COVID-19 pandemic on the treatment of psoriasis with systemic therapies in France: results from the PSOBIOTEQ cohort

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The PSOBIOTEQ study protocol was approved by the "Comité d'Evaluation de l'Ethique des projets de Recherche Biomédicale (CEERB) du GHU Nor" (Institutional Review Board [IRB] of Paris North Hospitals, Paris 7 University, AP-HP) (authorization No. JMD/MDM/177-11) registered on Clinical Trials.gov under the reference NCT01617018.

Abstract

Background: The nature of the COVID-19 pandemic led to concerns among patients and physicians about the potential impact of immunosuppressive treatments for chronic diseases such as psoriasis on the risk of severe COVID-19.

Objectives: To describe treatment modifications and determine the incidence of COVID-19 infection among psoriasis patients during the first wave of the pandemic, and identify the factors associated with these events.

Methods: Data from PSOBIOTEQ cohort relating to the first COVID-19 wave in France (March to June, 2020), as well as a patient-centred COVID-19 questionnaire, were used to evaluate the impact of lockdown on changes (discontinuations, delays or reductions) in systemic therapies, and to determine the incidence of COVID-19 cases among these patients. Logistic regression models were used to assess associated factors.

Results: Among the 1751 respondents (89.3%), 282 patients (16.9%) changed their systemic treatment for psoriasis, with 46.0% of these changes being initiated by the patients themselves. Patients were more likely to experience psoriasis flare-ups during the first wave if they changed their treatment during this period (58.7% vs 14.4%; $P<0.0001$). Changes to systemic therapies were less frequent among patients with cardiovascular diseases ($P<0.001$), and those aged ≥65 years ($P=0.02$). Overall, 45 patients (2.9%) reported having COVID-19, and eight (17.8%) required hospitalization. Risk factors for COVID-19 infection were close contact with a positive case ($P<0.001$) and living in a region with a high incidence of COVID-19 ($P<0.001$). Factors associated with a lower risk of COVID-19 were avoiding seeing a physician ($P=0.002$), systematically wearing a mask during outings ($P=0.011$) and being a current smoker ($P=0.046$).

Conclusions: Discontinuation of systemic psoriasis treatments during the first COVID-19 wave (16.9%) – mainly decided by patients themselves (46.0%) – was associated with a higher incidence of disease flares (58.7% vs 14.4%). This observation and factors associated with a higher risk of COVID-19 highlight the need to maintain and adapt patient–physician communication during health crises according to patient profiles, with the aim of avoiding unnecessary treatment discontinuations and ensuring that patients are informed about the risk of infection and the importance of complying with hygiene rules.

Keywords: Psoriasis; COVID-19; SARS-CoV-2; Systemic therapy; Biologic drug; Treatment compliance

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1. Introduction

Psoriasis is a highly prevalent, chronic, immune-mediated, inflammatory skin disease. Systemic therapies approved for the treatment of moderate-to-severe psoriasis include conventional agents, small molecules and biologic therapies [1]. The emergence of COVID-19 led to a national lockdown in France lasting from March 17 to May 11, 2020. Although most patients with COVID-19 experienced mild-to-moderate symptoms, 87,809 people (134 per 100,000) were hospitalized for COVID-19 and 15,661 people (24 per 100,000) died in hospital during the first COVID-19 wave in France [2]. The novel nature of COVID-19, and the known contribution of the innate and adaptive immune systems to the control of respiratory virus infections other than COVID-19 led to uncertainty among physicians about the increased risk of severe COVID-19 in patients being treated with systemic immunosuppressive/immunomodulatory therapies [3]. In addition, many of the comorbidities associated with psoriasis – including obesity, diabetes, and cardiovascular disease – were rapidly recognized as being associated with an increased risk of severe COVID-19 [4-6]. Thus, at the beginning of the COVID-19-related health crisis, it was debated whether systemic therapies for psoriasis, particularly biologics, should be interrupted to lower the risk of severe COVID-19 complications [3, 7, 8]. By contrast, as the level of understanding of COVID-19 increased, it was noted that systemic therapies might possibly play a beneficial role in patients with severe illness during the later stages of infection by limiting organ damage resulting from a dysregulated hyperinflammatory cascade [9]. Although many national and international dermatology societies rapidly released guidance promoting the continuation of systemic therapies for psoriasis, little is known about the extent and magnitude of any changes to the systemic treatment of psoriasis patients during the COVID-19 outbreak [8, 10-12]. Fear of the serious consequences of COVID-19 infection could have led patients to discontinue their systemic treatment, without consulting a dermatologist [13]. Furthermore, in many healthcare systems the pandemic led to difficulties in managing patients with chronic diseases because of the suspension of most outpatient services and the redeployment of physicians from other medical specialties to the care of COVID-19 patients [14]. The objectives of this study were to describe systemic treatment modifications during the first wave of the COVID-19 pandemic in France among psoriasis patients included in the French PSOBIOTEQ cohort [15-19], and to estimate the incidence of COVID-19 among these patients during this period. In addition, the factors associated with these events were evaluated.

2. Patients and methods

2.1 Study design and data sources

This study was conducted from June 1 to December 31, 2020, using real-world data from the PSOBIOTEQ cohort relating to the period of the first COVID-19 wave in France, as well as additional COVID-19-related data obtained via a patient questionnaire. PSOBIOTEQ is a French prospective, observational, multicenter, cohort study of adult patients with moderate-to-severe psoriasis treated with systemic therapies.

2.2 Population and data collection

Patients included in the PSOBIOTEQ cohort before the French lockdown on March 17 2020, and who were still being treated with systemic therapies at this time, were eligible for the current study. Patients were contacted by phone or asked during routine clinical practice visits to complete the COVID-19 questionnaire. Patients who completed at least one item of this questionnaire were included in the study. The questionnaire addressed: (1) precautions taken during the first COVID-19 wave: average number of weekly outings, whether the patient avoided seeing a physician and going to healthcare facilities, whether they washed their hands more often, and whether they systematically wore a mask during outings; (2) treatment management during the first COVID-19 wave: if any changes were made to systemic psoriasis treatments (discontinuation, delay or dose reduction) and the reasons for these modifications (patient decision, recommendations from a healthcare professional, factors related to the COVID-19 lockdown, e.g. consultations being suspended or treatment supply problems, or other reasons); (3) psoriasis flare-ups (*i.e.* periods of acutely worsening symptoms) during the first COVID-19 wave; and (4) COVID-19 outcomes during the first wave: close contact with suspected/confirmed COVID-19 case, COVID-19 infection (suspected or confirmed by clinical examination, virological test (polymerase chain reaction [PCR]) by a nasal swab, serological diagnosis or a characteristic chest CT-scan), and, in case of infection, symptom severity (hospitalization in a COVID-19 ward or intensive care unit, ICU, or death). Data regarding the hospitalization or death of psoriasis patients as a result of COVID-19 infection were confirmed from hospital records. Data extracted from the PSOBIOTEQ registry for each patient included: age, gender, phototype, educational level, region of residence, smoking status, significant comorbidities, psoriasis form and associated psoriatic arthritis, systemic psoriasis treatments (drug name and duration), and influenza vaccination status in the last 12 months.

2.3 Statistical analysis

All patients who provided answers to items in the COVID-19 questionnaire related to treatment modification during the first wave were included in the analyses for the first objective. Comparisons of the occurrence of psoriasis flare-ups during the first wave between patients who reported systemic treatment modifications and those who did not were analyzed using Pearson's chi-squared test. Logistic regression models, including univariate analysis followed by multivariate analysis with forward stepwise selection, were used to assess the association between treatment modification and the following potential factors: demographic characteristics, comorbidities, clinical features of psoriasis, treatment characteristics and precautions taken during the first wave.

All patients who provided a response to items in the questionnaire related to COVID-19 infection were included in the analyses for the second objective. As described for the first objective, univariate and multivariate logistic regression models were used to assess the association between COVID-19 infection and the following potential factors: demographic characteristics, clinical features of psoriasis, treatment characteristics, precautions taken during the first wave, and whether patient had been identified as a close contact of a suspected/confirmed COVID-19 case.

Data were expressed as the number and percentage of patients for categorical variables, and as the median and range (first and third quartiles, Q1-Q3) for continuous variables. Between-group comparisons were analyzed using Pearson's chi-squared test or Fisher's exact test, as appropriate, for categorical variables, and using an ANOVA test for continuous variables. Variables with a *P*-value <0.20 in the univariate analyses, and for which less than 20% of data were missing, were included in the multivariate analyses. All tests were two-tailed, and *P*-values <0.05 were considered statistically significant.

All analyses were performed using R software, version 3.5.1 (R Foundation for Statistical Computing).

3 Results

3.1 Study population

Among the 1960 patients eligible for the study, 1751 (89.3%) completed at least one item of the COVID-19 questionnaire (Fig. 1). The main characteristics of the study population are detailed in Table 1. The median age was 50 years ([Q1-Q3] range: 39-60) and 655 patients (37.9%) were female. Most patients had plaque-type psoriasis (91.2%), and psoriatic arthritis

was reported in 280 patients (16.0%). There were 438 obese patients (30.3%) and 482 current smokers (31.6%). On March 17, 2020, 347 patients (19.8%) were being treated with conventional/small molecule therapies only, and 1404 (80.2%) were being treated with biologics, including an interleukin (IL)-12/23 inhibitor (34.5%), tumor-necrosis-factor (TNF)-α inhibitors (30.1%), IL-17 inhibitors (21.3%), and IL-23 inhibitors (14.2%). The characteristics of the non-responder population were similar to those of the study population (Table 1).

3.2 Treatment modification and patient-related factors associated with treatment changes

Among the 1664 patients (95.0%) who answered questions related to treatment management, 282 (16.9%) reported discontinuing, delaying or reducing their psoriasis treatment during the first wave (including 19.7% of the patients on conventional/small molecule therapies and 16.3% of those on biologics). These drug modifications were decided by the patient (46.0%), related to the COVID-19 lockdown (18.0%), recommended by a dermatologist (16.2%) or by a general practitioner (14.0%), or occurred for other reasons (5.8%). Psoriasis flare-ups during this period were more frequent in patients who had discontinued, delayed or reduced their treatment than in those who had not modified their treatment (58.7% vs 14.4%*; P*<0.0001). Univariate analysis revealed that the following factors were associated with increased likelihood of treatment modification during the first COVID-19 wave (Table 2): age <65 years, higher educational level, living in a region with a high COVID-19 incidence, absence of comorbidities including obesity, diabetes and cardiovascular disease, treatment with conventional/small molecules rather than biologics, smoking, and not having being vaccinated against influenza in the last 12 months. Data on educational level were missing for 39.0% of patients and this factor was therefore excluded from the multivariate analysis. Multivariate analysis revealed that patients were significantly less likely to have modified their systemic treatment if they had cardiovascular disease (adjusted-odds-ratio [aOR]: 0.48; 95% confidence interval, CI: [0.31; 0.74], *P*<0.001) or if they were ≥ 65 years old (aOR: 0.55; 95% CI [0.32; 0.94], *P*=0.02).

3.3 Occurrence and factors associated with COVID-19 infection

Among the 1534 patients (87.6%) who answered questions related to COVID-19 infection during the first wave, 45 (2.9%) reported having been infected with SARS-CoV-2, including 41 confirmed cases. Cases were confirmed by clinical examination (83.7%), PCR testing

(56.1%), serological diagnosis (31.8%) or an evocative chest CT-scan (17.5%). Eight of 45 infected patients with COVID-19 (17.8%) were hospitalized due to COVID-19: four (8.9%) in an ICU. No deaths were reported during the study period. According to the univariate analyses (Table 3), the following factors were associated with a higher risk of COVID-19 infection during the first wave: age<65 years, living in a region with a high COVID-19 incidence, being a non-smoker, a shorter duration of the current systemic psoriasis treatment, taking fewer precautions during the first wave (not avoiding seeing a doctor or going to healthcare facilities, or not systematically wearing a mask during outings) and being a close contact of a suspected/confirmed COVID-19 case.

The multivariate analysis revealed that patients were significantly more likely to have had COVID-19 during the first wave if they had been in close contact with a suspected/confirmed COVID-19 case or if they were living in a region with a high COVID-19 incidence. In addition, patients had a lower risk of COVID-19 if they avoided seeing a doctor, if they systematically wore a mask during outings, or if they were current smokers (Table 4).

4. Discussion

In this study, nested in the PSOBIOTEQ cohort, 16.9% of the patients reported systemic treatment modifications (discontinuations, delays or reductions) during the first wave of the pandemic, including 19.7% of patients on conventional/small molecule therapies and 16.3% of those on biologics. The decision to modify treatment was taken by the patients themselves (46.0% of cases) or recommended by a healthcare professional (30.2% of cases). It should also be noted that 18.0% of patients reported having difficulty accessing healthcare during the lockdown period, due to consultations being suspended or to treatment supply problems. The proportion of patients reporting treatment modifications in our study was very close to that found in another French cohort of 1335 patients with psoriasis on systemic therapies: 16.0% of the patients in this previous study discontinued treatment, including 22.4% of those on conventional/small molecule therapies and 13.8% of those on biologics [20]. Similarly, in a global self-reported cross-sectional study of patients from 86 countries (PsoProtectMe), 284 of the 1541 participants receiving systemic therapies for psoriasis (18.4%) reported having modified their treatment during the pandemic [21]. However, some European studies have reported more variable rates of treatment modification among psoriasis patients during the COVID-19 pandemic, with higher rates being reported in Greece (23.6%) and Spain (26.7%),

and lower rates being reported in Italy (5.2% and 6.7%), Germany (9.8%), the Czech Republic (1.2%) and Denmark (7.3%) [13, 22-27]. Likewise, a retrospective study performed using the French National Health Insurance database (SNDS) found that psoriasis patients largely maintained their treatments during the COVID-19 pandemic [28]. However, this study relied on delivery data, which may not have been accurate enough to identify short-term treatment changes. In addition to differences in study design, discrepancies between discontinuation rates may also be explained by differences in national or regional COVID-19 incidence rates, the resources and organization of healthcare systems, levels of patient empowerment in relation to their treatment, communication about the importance of continuing systemic treatment, lockdown regulations, legal requirements, media coverage, and sociocultural habits [26]. In Denmark, patients who modified their treatment during the pandemic reported that they generally felt less safe with their treatment, highlighting the need to identify such patients and ensure that they are provided with appropriate information [13]. In our study, age and cardiovascular comorbidities were independently associated with the decision to discontinue, delay or reduce treatment during the first wave. Younger participants (aged<65 years) were more likely to change therapy. This may appear paradoxical as older age is a known risk factor for severe COVID-19. However, older patients have been found to be more compliant with treatment than younger patients in previous studies [29, 30]. Furthermore, we observed that patients without cardiovascular diseases were more likely to change therapy. Although not statistically significant, we observed the same trend with other chronic comorbidities (*e.g.,* diabetes, obesity, cancer, and chronic liver and kidney diseases). These observations may be associated with the fact that patients with chronic comorbidities may have had reasons, other than psoriasis, to consult a healthcare professional during the first COVID-19 wave, and were therefore advised to maintain their systemic psoriasis treatment. Other studies have shown that psoriasis patients using biologics exhibited better treatment compliance than those receiving conventional drugs [20, 31]. Although not statistically significant, we observed the same trend in our study: patients being treated with conventional agents or small molecules were more likely to have modified their treatment during the first COVID-19 wave in France than those being treated with biologics. Finally, our univariate analysis revealed that smoking and not having received a recent influenza vaccination were positively associated with systemic treatment modifications during the first wave. Such results were expected because these variables are proxy indicators of a lack of adherence to public health recommendations.

Psoriasis flare-ups during the first wave were more frequent in patients who had discontinued, delayed or reduced their treatment than in those without any treatment modifications. These short-term modifications to systemic therapy can have longer-term consequences, as they can result in a loss of response when treatments are reintroduced or subsequently increased, and may even result in the formation of antibodies to the discontinued biologic [32-34]. Typically, the reasons given for discontinuation in previous studies were related to a fear of developing severe COVID-19 and to restrictions on patient movement during lockdown [35]. These findings highlight the importance of providing an easy mode of communication between patients and physicians to provide clinical and emotional support for patients [36]. Indeed, recent studies have suggested that providing easy access to in-person consultations or teleconsultations during future lockdowns may reduce the number of patients modifying their systemic treatment [37-39]. However, there is a need to develop standardized tools specially adapted for telemonitoring diseases [35].

Of the 1534 patients receiving systemic therapy during the study period, 45 patients (2.9%) were infected with COVID-19 during the first wave, with eight of these patients (0.5%) requiring hospitalization and four (0.3%) needing ICU care. None of the patients died. These results are consistent with those of a previous study conducted during the first wave of the pandemic in Spain and involving the BIOBADADERM cohort [40].

A significantly higher risk of COVID-19 infection was observed for patients identified as close contacts of confirmed/suspected COVID-19 cases, those living in a region with a high COVID-19 incidence, and those who reported not systematically wearing a mask during outings. These observations highlight the importance of advising and empowering patients to carefully comply with hygiene rules, use protective equipment, and maintain social distancing during COVID-19 waves. In addition, our findings showed that patients were significantly less likely to have caught COVID-19 if they avoided medical consultations during the first wave in France. Although in-person consultations may be associated with an inherent risk of infection, for example through coming into contact with a COVID-19 case in a waiting room, avoiding physician visits may be reflective of a more general behavior pattern of avoiding potentially high-risk contact situations. Finally, we identified being a current smoker as a protective factor against COVID-19 infection. Similar findings have already been reported in several studies, including those involving prospective cohorts. The current hypothesis is that nicotine may help to prevent SARS-CoV-2 infection due to the proximity of the nicotinic and angiotensin-converting-enzyme-2 (ACE2) receptors [41-46].

The strengths of the present study include the real-life design, the size of the study population and the sampling of patients from a national database covering all of metropolitan France, the detailed assessments of patient factors, and the independent method of data analysis. Nevertheless, this study had some limitations. Although the study was nested in a prospective cohort study, the retrospective design was prone to recall bias. However, this bias was likely limited by the fact that our study was conducted immediately after the first COVID-19 wave. Another potential limitation was non-response, potentially resulting in selection bias. In our study the response rate was high, with 89.3% of patients answering at least one question in the COVID-19 questionnaire. Furthermore, the characteristics of the non-responder population were similar to those of the study population. Last, PCR testing access varied over time and testing was often not done in cases of mild courses of the disease during the first wave of the COVID-19 pandemic. Thus, the incidence of infection in the PSOBIOTEQ cohort may be underestimated.

Our study evaluated the reasons for drug modification (patient decision, recommendation from a healthcare professional, factors related to the COVID-19 lockdown, or other reasons). Although we did not investigate the underlying motivations behind these patient decisions, our study highlighted, for the first time, the profile of the patients that changed their systemic treatments during the first wave of the COVID-19 pandemic. Finally, the number of patients hospitalized due to COVID-19 in our study was relatively low and therefore did not allow for comparative analysis of the putative risk of severe infection between patients in our cohort receiving biologics versus those receiving conventional therapies. Additionally, the small number of COVID-19 cases reported limited the power of the study to identify risk factors for COVID-19 infection.

In conclusion, this study described the impact of the first wave of the COVID-19 health crisis in France on the treatment of psoriasis patients following systemic therapies. These data highlight the importance of maintaining and adapting patient–physician communication during health crises according to patient profiles, with the aim of avoiding unnecessary treatment discontinuations and ensuring patients are informed about the risk of infection and the importance of complying with hygiene rules.

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Disclosure of interest

HA, YD, ES, and OC have no conflicts of interest to disclose.

EM is a consultant and has received speaker remunerations from Novartis, AbbVie, LEO Pharma, Lilly, Celgene, Amgen, and Janssen-Cilag.

MAR is a consultant for Pfizer, LEO Pharma, Janssen, Galderma, AbbVie, Novartis, Pierre Fabre, Merck and BMS.

MV has undertaken activities as a paid consultant, adviser or speaker for Janssen, AbbVie, MSD, Pfizer, LEO Pharma, Medac, Boehringer Ingelheim, Novartis and Arrow.

MBB offers a consultancy service and is an investigator for AbbVie, Amgen, Celgene, Janssen, LEO Pharma, Lilly, MSD, Novartis and Pfizer.

AD has undertaken activities as a paid consultant for Sanofi-Aventis, outside of the submitted work.

NB has been an investigator for Pfizer and Novartis. She is currently a consultant for Janssen and has received speaker remuneration from Janssen.

PJ is a consultant for Roche, GSK, Lilly, Principia Biopharma, and Sanofi-Aventis.

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HB has undertaken activities as a paid consultant, adviser or speaker for AbbVie, Almirall, Anaptysbio, Amgen, Aristea Therapeutics, Boehringer Ingelheim, Bristol Myers Squibb, Celgene, Janssen, LEO Pharma, Lilly, Novartis, Pfizer, UCB and Xion Pharmaceuticals. He has also received grant funding from Bristol Myers Squibb, Janssen, LEO Pharma and Pfizer.

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Figure 1. Flowchart of patient participation in the study

Table 1. Characteristics of PSOBIOTEQ patients being treated with systemic therapies at the start of lockdown, including those who provided data for at least one COVID-19 variable during the study period (study population) and those who did not provide data for any COVID-19 variables during the study period (non-responder population)

Patient characteristics, *missing data in the study population n (%)*	Study population (N=1751)	Non-responder population (N=209)
Gender, female	655 (37.4)	75 (35.9)
Age (years)	50 (39-60)	53 (43-64)
Phototype (Fitzpatrick), *n=360 (20.6)*		
I-II	376 (27.0)	41 (25.5)
III-IV	926 (66.6)	105 (65.2)
V-VI	89 (6.4)	15 (9.3)
Educational level, > Baccalaureate [a], *n=692 (38.4)*	391 (36.9)	36 (31.6)

Living in a region with a high COVID-19 incidence [b]	653 (37.3)	90 (43.1)
Current smoker, *n=228 (17.1)*	482 (31.6)	18 (40.0)
Comorbidities		
Obesity (BMI>30 kg/m^2), *n=305 (17.4)*	438 (30.3)	47 (29.2)
Significant comorbidities		
Diabetes	198 (11.3)	31 (14.8%)
Psychiatric disease	137 (7.8)	21 (10.0%)
Cardiovascular disease	437 (25.0)	69 (33.0%)
Chronic lung disease	125 (7.1)	19 (9.1%)
Chronic liver disease	143 (8.2)	12 (5.7%)
Chronic kidney disease	30 (1.7)	2 (1.0%)
Cancer (including patients in remission)	105 (6.0)	6 (2.9%)
Psoriasis		
Familial psoriasis, *n=158 (7.2)*	741 (45.7)	79 (41.6)
Plaque psoriasis, *n=80 (3.6)*	1545 (91.2)	178 (89.0)
Psoriatic arthritis	280 (16.0)	31 (14.8%)
Treatments		
Duration of current treatment before the 1st wave (days)	610 (250-1095)	456 (215-985)
Systemic therapies at the start of the 1st wave		
Conventional agents or small molecules	**347 (19.8)**	**47 (22.5)**
Acitretin	*3 (0.9)*	*3 (6.4)*
Methotrexate	*275 (79.3)*	*33 (70.2)*
Cyclosporine	*15 (4.2)*	*1 (2.1)*
Apremilast	*54 (15.6)*	*10 (21.3)*
Biologic therapies	**1404 (80.2)**	**162 (77.5)**
TNF-α inhibitors	422 (30.1)	53 (32.7)
Etanercept	*51 (12.1)*	*2 (3.8)*
Adalimumab	*335 (79.4)*	*43 (81.1)*
Infliximab	*23 (5.5)*	*3 (5.7)*
Certolizumab	*13 (3.1)*	*5 (9.4)*
IL-17 inhibitors	299 (21.3)	39 (24.1)
Secukinumab	*112 (37.5)*	*11 (28.3)*
Ixekizumab	*153 (51.1)*	*21 (53.8)*
Brodalumab	*34 (11.4)*	*7 (17.9)*
IL-12/23 inhibitor	484 (34.5)	45 (27.8)
Ustekinumab	*484 (100)*	*45 (100)*
IL-23 inhibitors	199 (14.2)	25 (15.4)
Guselkumab	*177 (88.9)*	*24 (96.0)*
Risankizumab	*22 (11.1)*	*1 (4.0)*
Influenza vaccination in the last 12 months, yes	349 (19.9)	23 (11.0)

BMI, Body Mass Index; TNF-α, Tumor Necrosis Factor alpha; IL, Interleukin

Data presented are the median (Q1-Q3 range) for continuous variables, and the number and percentage of patients, n (%), for categorical variables.

[a] In France, the baccalaureate is an examination intended to qualify successful candidates for higher education.

[b] French regions with a high prevalence of COVID-19 during the first wave were Île-de-France, Hauts-de-France and Grand-Est[35].

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Table 2. Univariate analysis of the factors associated with discontinuation, delay or reduction of systemic psoriasis treatment during the first COVID-19 wave in France (N=1664)

Characteristics, *missing data n (%)*	Patients with treatment modification (n=282)	Patients without treatment modification (n=1382)	*P* value [a]
Gender, female	111 (39.4)	512 (37.0)	0.464
Age, <65 years old [b]	256 (90.8)	1132 (81.9)	**<0.001**
Phototype (Fitzpatrick), *n=347 (20.9)*			
I-II	58 (26.6)	294 (26.8)	0.869
III-IV	144 (66.1)	735 (66.9)	
V-VI	16 (7.3)	70 (6.4)	
Educational level, > Baccalaureate [c], *n=649 (39.0)*	89 (48.6)	288 (34.6)	**0.001**
Living in a region with a high COVID-19 incidence [b, d]	117 (41.5)	514 (37.2)	**0.175**
Current smoker [b], *n=215 (12.9)*	94 (38.1)	363 (30.2)	**0.016**
Comorbidities			
Obesity (BMI>30 kg/m^2) [b], *n =283 (17.0)*	58 (24.7)	361 (31.5)	**0.038**
Significant comorbidities			
Diabetes [b]	12 (4.3)	177 (12.8)	**<0.001**
Psychiatric disease	23 (8.2)	107 (7.7)	0.814
Cardiovascular disease [b]	38 (13.5)	374 (27.1)	**<0.001**
Chronic lung disease	24 (8.5)	89 (6.4)	0.208
Chronic liver disease	20 (7.1)	120 (8.7)	0.380
Chronic kidney disease	4 (1.4)	25 (1.8)	0.806
Cancer (including patients in remission)	14 (5.0)	81 (5.9)	0.554
Psoriasis			
Plaque psoriasis, *n=56 (3.4)*	251 (91.9)	1213 (90.9)	0.569
Psoriatic arthritis	47 (16.7)	227 (16.4)	0.921
Systemic treatments			
Duration of current systemic treatment before the 1st wave (days)	630 (278-1181)	602 (238-1098)	0.228
Biologics at the start of the 1st wave [b]	217 (77.0)	1117 (80.8)	**0.137**
Influenza vaccination in the last 12 months [b]	43 (15.2)	287 (20.8)	**0.034**
Precautions during 1st wave			
Average number of weekly outings during the 1st wave, *n=282 (16.9)*	2 (1-5)	2 (1-6)	0.602
Patient avoided seeing a physician, *n=222 (13.3)*	84 (35.4)	388 (32.2)	0.331
Patient avoided going to healthcare facilities, *n=233 (14.0)*	90 (38.1)	420 (35.1)	0.381
Patient washed their hands more often (including with a hydro alcoholic solution), *n=246 (14.8)*	213 (91.0)	1050 (88.7)	0.294
Patient systematically wore a mask during outings, *n=328 (19.7)*	162 (74.7)	814 (72.7)	0.562

BMI, Body Mass Index

Data presented are the median (Q1-Q3 range) for continuous variables, and the number and percentage of patients, n (%), for categorical variables.

[a] *P* values were determined using Pearson's chi-squared test or Fisher's exact test, as appropriate, for categorical variables and an ANOVA test for continuous variables.

[b] Variables selected for the multivariate analyses.

[c] In France, the baccalaureate is an examination intended to qualify successful candidates for higher education

[d] French regions with a high prevalence of COVID-19 during the first wave were Île-de-France, Hauts-de-France and Grand-Est[35].

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Table 3. Univariate analysis of factors associated with COVID-19 infection during the first wave (N=1534)

Characteristics, *missing data n (%)*	Patients infected with COVID-19 (n=45)	Patients not infected with COVID-19 (n=1489)	*P* value [a]
Gender, female	18 (40.0)	556 (37.3)	0.716
Age < 65 years old [b]	41 (91.1)	1238 (83.1)	**0.157**
Living in a region with a high COVID-19 incidence [b, c]	32 (71.1)	560 (37.6)	**<0.001**
Current smoker, *n=142 (9.3)*[b]	9 (22.0)	425 (31.5)	**0.195**
Psoriasis			
Plaque psoriasis, *n=53 (3.5)*	41 (95.3)	1303 (90.6)	0.424
Psoriatic arthritis	9 (20.0)	234 (15.7)	0.438
Systemic treatments			
Duration of current systemic treatment before the 1st wave (days)[b]	453 (124-1160)	631 (260-1124)	**0.177**
Biologics at start of the 1st wave	33 (73.3)	1181 (79.3)	0.331
Precautions taken during the 1st wave			
Average number of weekly outings during the 1st wave, *n=120 (7.8)*	2 (1-5)	2 (1-6)	0.742
Patient avoided seeing a physician, *n=59 (3.8)*[b]	5 (11.6)	472 (33.0)	**0.003**
Patient avoided going to healthcare facilities, *n=70 (4.6)*[b]	9 (20.9)	507 (35.7)	**0.046**
Patient washed their hands more often (including with a hydro alcoholic solution), *n=82 (5.3)*	37 (86.0)	1255 (89.1)	0.464
Patient systematically wore a mask during outings, *n=171 (11.1)*[b]	20 (54.1)	976 (73.6)	**0.008**
COVID-19 outcomes			
Close contact with suspected/confirmed COVID-19 case, n=17 (1.1)[b]	25 (55.6)	110 (7.5)	**<0.001**

Data presented are the median (Q1-Q3 range) for continuous variables, and the number and percentage of patients, n (%), for categorical variables.

[a] *P* values were determined using Pearson's chi-squared test or Fisher's exact test, as appropriate, for categorical variables and an ANOVA test for continuous variables.

[b] Variables selected for the multivariate analyses.

[c] French regions with a high prevalence of COVID-19 during the first wave were Île-de-France, Hauts-de-France and Grand-Est[35].

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Table 4. Factors associated with COVID-19 infection during the first wave according to the multivariate analysis (N=1,222)

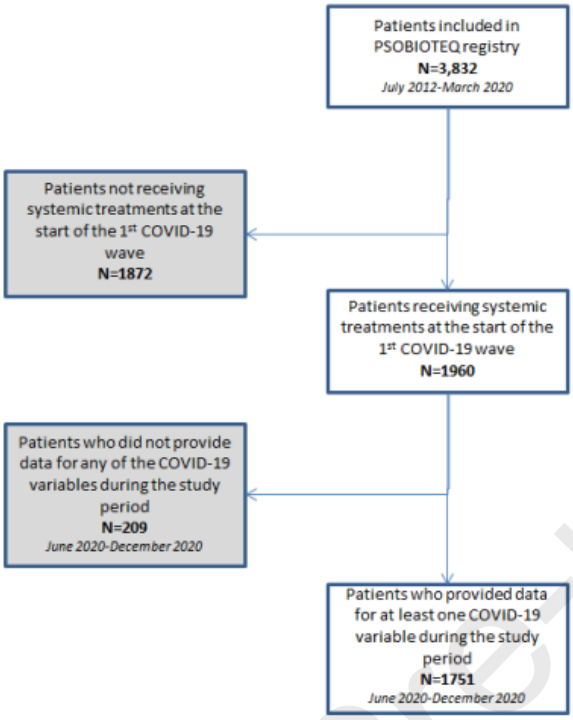
Variables	Odds ratio 95% CI	*P value*
Close contact with suspected/ confirmed COVID-19 case		
No	1	<0.001
Yes	12.40 [5.87; 26.19]	
Living in a region with a high COVID-19 incidence [a]		
No	1	<0.001
Yes	5.43 [2.40; 12.30]	
Patient avoided seeing a physician		
No	1	0.002
Yes	0.20 [0.06; 0.69]	
Patient systematically wore a mask during outings		
No	1	
Yes	0.37 [0.17; 0.78]	0.011
Current smoker		
No	1	0.046
Yes	0.42 [0.17; 1.04]	

[a] French regions with a high prevalence of COVID-19 during the first wave were Île-de-France, Hauts-de-France and Grand-Est[35]

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Figure 1

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