Nadia NINOSU[1]
Fabio ROEHRICH[1]
Katharina DIEHL[2]
Wiebke K. PEITSCH[3]
Marthe-Lisa SCHAARSCHMIDT[1]

[1] Department of Dermatology, Venereology and Allergology, University Medical Center Mannheim, Heidelberg University, Theodor-Kutzer-Ufer 1-3, 68167 Mannheim, Germany
[2] Mannheim Institute of Public Health, Social and Preventive Medicine, Medical Faculty Mannheim, Heidelberg University, Ludolf-Krehl-Str. 7-11, 68167 Mannheim, Germany
[3] Department of Dermatology and Phlebology, Vivantes Klinikum im Friedrichshain, Landsberger Allee 49, 10249 Berlin, Germany

Reprints: Marthe-Lisa Schaarschmidt
<marthe-lisa.schaarschmidt@umm.de>

Psoriasis care during the time of COVID-19: real-world data on changes in treatments and appointments from a German university hospital

Background: COVID-19 poses significant challenges for care of patients with chronic inflammatory skin diseases including psoriasis. *Objectives:* To investigate changes in treatment and/or appointments for psoriasis patients in a German university hospital due to the pandemic. *Materials & Methods:* A postal survey was conducted between May 15 and June 15, 2020. Potential determinants of changes were analysed with descriptive statistics and multivariate logistic regression. *Results:* Out of 205 respondents, 19.5% missed an appointment and 9.8% changed therapy due to the pandemic. Treatment alterations were encouraged by patients (50%) and physicians (40%), whereas cancellations of appointments mostly occurred on patients' request (70%). Several patient-related key drivers of changes, including sociodemographic, disease- and health-related characteristics were identified. Changes in treatment and appointments were associated with higher psoriasis severity scores and more frequent disease aggravations. *Conclusion:* It is particularly crucial to tailor psoriasis care to individual needs in order to protect the physical and mental well-being of patients during the pandemic.

Key words: adherence, biologicals, coronavirus, COVID-19, pandemic, psoriasis

The first case of coronavirus disease 19 (COVID-19) was detected in December 2019 in China. Since then, the infection rapidly spread throughout the world, causing millions of confirmed cases and deaths [1]. As a result, the World Health Organization (WHO) declared the COVID-19 outbreak a pandemic in March 2020.

The pandemic poses significant challenges for the global health care systems, as health care resources have to be reallocated and social distancing behaviours impair access to health services. In dermatology, patients with chronic inflammatory skin diseases such as psoriasis are severely affected by the pandemic. On the one hand, they require continuous care both due to their skin condition and due to psoriasis-associated physical and mental comorbidities [2]. On the other hand, numerous patients with moderate-to-severe psoriasis receive systemic immunosuppressive or immunomodulating therapies. Patients and physicians rely on these therapies due to their proven efficacy and safety [3, 4]. However, the new and unforeseeably changing situation gave rise to concerns that systemic psoriasis treatments may increase the risk for and severity of severe acute respiratory syndrome virus 2 (SARS-CoV-2) infections. At the beginning of the pandemic, an extensive and partly controversial debate emerged on the use of systemic agents in psoriasis [5-10]. Meanwhile, dermatological societies recommended continuing these therapies in most COVID-19-negative and asymptomatic patients and initiating novel systemic therapies if required after individual risk-benefit assessment [11-16]. In any case, patients should not change or stop therapy without consulting their physicians.

Clearly, discontinuation or delayed initiation of therapy can result in psoriasis flares. During the first wave of the pandemic, the number of outpatient visits in dermatological hospitals and practices was significantly reduced [17]. On the one hand, providers had to cut non-urgent routine visits. On the other hand, patients postponed appointments [17]. Missing physician's appointments poses risks of under-treatment, insufficient monitoring, and non-recognition of adverse events.

The aim of our study was to investigate changes in treatment and/or appointments of psoriasis patients in a German university hospital due to the pandemic. Furthermore, we aimed to determine reasons for, and determinants of, these changes.

Materials and methods

Study cohort

Inclusion criteria were: age ≥18 years; physician-confirmed diagnosis of psoriasis; consultation at outpatient clinics of the Dermatology Department of the University Medical Center Mannheim between January 1, 2019, and May 1, 2020 due to psoriasis; and ability to provide informed consent. The time span was chosen in order to select patients with recently active psoriasis. Eligible patients were identified through the appointment calendar. All patients fulfilling the inclusion criteria were contacted

by mail. We decided to send our questionnaires by ordinary mail, first because we do not request e-mail addresses of patients who visit our psoriasis clinics routinely, second, e-mail delivery of study documents is not considered data-secure in Germany, and third telephone interviews were considered less suitable for completing the questionnaire (*supplementary file S1*). The study was performed in accordance with the Declaration of Helsinki and approved by the Ethics Committee of the Medical Faculty Mannheim (reference no. 2020-548N).

Data collection

A patient information sheet, two copies of the informed consent form, the questionnaire (*supplementary file 1*) and a prepaid envelope were sent to all eligible patients on May 15, 2020. Patients willing to participate were asked to return signed informed consent and the completed questionnaire until June 15, 2020.

The survey contained questions on demographics, medical history (self-perceived impairment of the general health on a 5-point scale [range: 0 = none to 4 = very much], comorbidities [self-reported by choosing out of a list of options and free text if required], increased susceptibility to infections [yes/no], disease duration [years since onset of the first symptoms of psoriasis]) and psoriasis severity scores (patient-assessed Body Surface Area [BSA] and Dermatology Life Quality Index [DLQI]) [18]. In addition, participants were asked for their current psoriasis therapy, whether therapy had changed due to the pandemic, the respective therapy that was changed, duration of this therapy (in months) and treatment satisfaction on a 5-point scale (range: 1 = very dissatisfied to 5 = very satisfied). Treatment options were subdivided into topical treatments, phototherapy, systemic non-biologic medication, and biologicals. Both generic and brand names were presented for all approved systemic drugs. Unlisted drugs could be indicated as free text. Multiple answers were permitted.

In addition, participants were asked to provide information about treatment changes due to the pandemic (yes/no). Those who reported changes were asked to specify the drug, the kind of alteration (treatment discontinuation, pause, dosage modification, or change of drug), the reason for the change, and whether the change was discussed with the physician.

Moreover, the survey contained questions on missed psoriasis-related appointments due to the pandemic (yes/no; if yes: rescheduled or cancelled). Participants who reported alterations were asked to indicate the initiator (patient or medical provider) and to specify the main reason if the change was requested by the patient (fear of SARS-CoV-2 infection, disease other than COVID-19, SARS-CoV-2 infection or other reasons that could be specified as fee text).

Concerns about the patient's own health due to the pandemic, continuation of the psoriasis therapy during the pandemic and a more severe course of COVID-19 because of the current psoriasis therapy were measured on 5-point scales (from 0 = none to 4 = very high). Furthermore, questions also addressed the probability of reducing future psoriasis-related appointments due to the pandemic (0 = in no case, 4 = definitely) and, in cases of planned reductions, feared sources of SARS-CoV-2 infection (medical staff/other patients/on the way to the appointment/other). Participants were also asked for perceived changes in psoriasis severity due to the pandemic (no change/improvement/aggravation). Those who stated an aggravation were asked for the supposed reason.

Lastly, the survey contained information on SARS-CoV-2 infections affecting the participants, household members and/or close acquaintances as well as on protective measures used against SARS-CoV-2 (degree of decreased social contact and mask use).

Statistical analyses

In a first step, we conducted univariate analyses to describe changes in appointments and treatments during the COVID-19 pandemic. In a second step, we used descriptive statistics to identify associations between missed appointments and therapy change (both: yes vs. no) on the one hand and sociodemographic, disease-, health-, and treatment-related characteristics, as well as impairment by the pandemic on the other hand. For parametric independent variables, differences between subgroups were tested for statistical significance with unpaired t-tests. For non-parametric variables Mann-Whitney-U tests were performed. Chi-square tests were used for binary and categorical variables.

In a third step, we further investigated variables that showed significant associations with the two dependent variables in bivariate analysis by using logistic regression analysis. The models contained missed appointments or treatment change, respectively, as dependent variables, and sex, age, DLQI, BSA, number of comorbidities, systemic treatment (with non-biologic drugs or biologicals) and concern about health because of the pandemic as independent variables. Further variables that showed significant associations in bivariate analysis were omitted because of multicollinearity (*e.g.*, impairment of general health was highly correlated with number of comorbidities, and depression with worry about health). Data were analysed using IBM SPSS Statistics 25. The pre-defined level of significance was $p < 0.05$.

Results

Study population

In total, 568 individuals (41.7% females; mean age: 53.1 years) were contacted by mail, and 205 returned completed questionnaires, all of which were valid for data analyses, corresponding to a response rate of 36.1%. The questionnaires were completed between May 20, 2020 (176,007 confirmed COVID-19 cases and 8,090 deaths in Germany) and June 15, 2020 (186,461 COVID-19 cases and 8,791 deaths) [1].

Missed appointments because of the pandemic

In total, 40 patients (19.5%) missed at least one psoriasis-related appointment because of the pandemic, of which 22 (55%) were rescheduled and 18 (45%) cancelled (*table 1*). Most cancellations occurred on patients' request (70.0%) due to fear of SARS-CoV-2 infection (62.5%).

Table 1. Changes in appointments and treatments during the COVID-19 pandemic.

	All n = 205 (%)
Missed at least one psoriasis-related appointment with a physician because of the pandemic, n (%)	
No	165 (80.5)
Yes	40 (19.5)
Rescheduled	22 (10.7)
Cancelled	18 (8.9)
Reason for missed appointment[a], n (%)	
Patient-related	28 (70.0)
Fear of SARS-CoV-2 infection	25 (62.5)
Disease other than COVID-19	3 (7.5)
Medical provider-related	12 (30.0)
Other reasons[b]	0 (0)
Change in psoriasis treatment because of the COVID-19 pandemic, n (%)	
No	185 (90.2)
Yes	20 (9.8)
Change in psoriasis treatment[c], n (%)	
Topical therapy	3 (15.0)
Phototherapy	1 (5.0)
Non-biological systemic therapy	1 (5.0)
Methotrexate	1 (5.0)
Biological	15 (75.0)
TNF-α inhibitor	6 (30.0)
Adalimumab	5 (25.0)
Certolizumab pegol	1 (5.0)
IL-17 inhibitor	4 (20.0)
Secukinumab	4 (20.0)
IL-23 inhibitor	5 (25.0)
Guselkumab	3 (15.0)
Risankizumab	2 (10.0)
Type of treatment change[c], n (%)	
Paused	10 (50.0)
Stopped	1 (5.0)
Switched	4 (20.0)
Altered dosing regime[d]	3 (15.0)
Not specified	2 (10.0)
Reasons for treatment change[c,e], n (%)	
Patient's request	10 (50.0)
Physician's recommendation	8 (40.0)
Sickness other than COVID-19	3 (15.0)
Other reasons[f]	3 (15.0)
Not specified	2 (10.0)
Change in treatment after consultation with a physician[c], n (%)	
No	10 (50.0)
Yes	10 (50.0)

[a] For calculation of proportions, the number of participants in the subgroup that missed an appointment (n = 40) was set to 100%. [b] Other reasons could be specified as free text. However, no participant stated other reasons. [c] For calculation of proportions, the number of participants in the subgroup that changed treatment (n = 20) was set to 100%. [d] Dosing alteration comprised less frequent use of therapy (n = 2) and more frequent application of topical therapy during home office (n = 1). [e] Multiple answers were permitted. [f] Other reasons could be specified as free text: insufficient drug supply n = 3. COVID: coronavirus disease; IL: interleukin; n: number; SARS-CoV-2: severe acute respiratory syndrome virus 2; TNF-α: tumour necrosis factor-α

Treatment changes because of the pandemic

Twenty respondents (9.8%) modified their psoriasis therapy due to the pandemic (*table 1*). Among these, biological therapy (tumour necrosis factor-α [TNF-α] antagonists: n = 6; interleukin (IL)-17 inhibitors: n = 4; IL-23 inhibitors: n = 5) was changed in 15 (75%). Alterations in non-biological drugs (methotrexate: n = 1), topical therapy (n = 3) and phototherapy (n = 1) were rare.

Treatment was mostly paused (50%) or switched (20%). Alterations in the dosing regimen were reported by three participants (less frequent use: n = 2, more frequent application of topical therapy during home office: n = 1). One participant stopped therapy and two participants did not specify the kind of change. Most alterations occurred on patients' request (n = 10), followed by physicians' recommendations (n = 8), and in some cases, due to a disease other than COVID-19 (n = 3) and insufficient drug supply (n = 3). Six participants indicated two reasons (patient's request and physician's recommendation: n = 4; disease other than COVID-19 and physician's recommendation: n = 2) and two participants did not specify the reason. Half of the treatment alterations were made without consulting a physician. Details on treatment changes are presented in *supplementary table S1*.

Characteristics of the study cohort and their association with missed appointments and changes in treatment

Sociodemographic and disease- and health-related characteristics

Among 205 participants, 46.8% were female, and the mean age was 55.5 years. Most participants lived in a partnership (64.9%). The mean self-reported BSA was 6.5, the mean DLQI was 4.6 and the mean disease duration was 23.2 years. In total, 78.0% suffered from at least one comorbidity, with psoriatic arthritis (44.9%), arterial hypertension (42.4%) and allergies (26.8%) stated most frequently. On average, patients reported 1.7 comorbidities. Mean self-reported impairment of general health was 1.5 on a 5-point scale (*table 2*).

According to subgroup analyses, younger patients were more likely to change therapy ($p = 0.01$) (*table 2*). Participants who missed appointments and those who changed therapy had a significantly higher BSA ($p = 0.03$ and $p = 0.01$, respectively) and DLQI ($p = 0.01$ and $p = 0.01$, respectively) than their counterparts. Depression ($p = 0.001$), anxiety disorder ($p = 0.012$), allergies ($p = 0.036$) and neoplasia ($p = 0.021$) were positively associated with missed appointments. Arterial hypertension was negatively associated with therapy change ($p = 0.033$). Those who missed appointments had a significantly higher number of comorbidities than those who did not miss appointments ($p = 0.017$). Furthermore, impairment of general health and self-perceived susceptibility to infections were higher in those who changed therapy ($p = 0.042$ and $p = 0.041$, respectively) and those who missed consultations ($p = 0.022$ and $p = 0.002$, respectively).

Treatment characteristics

All participants obtained antipsoriatic treatment at the time of study participation, most frequently biologicals (71.2%),

Table 2. Sociodemographic and disease- and health-related characteristics of all participants and subgroups with changes in appointments and/or therapy.

Characteristic	All	Missed appointment			Therapy change		
	n = 205	Yes, n = 40	No, n = 165	p[a]	Yes, n = 20	No, n = 185	p[a]
Sex, n (%)							
Female	96 (46.8)	18 (45.0)	78 (47.3)	0.800	12 (60.0)	84 (45.4)	0.210
Male	109 (53.2)	22 (55.0)	87 (52.7)		8 (40.0)	101 (54.6)	
Age (yrs), mean (SD; min-max)	55.5 (15.2; 19-91)	55.6 (14.1;26-85)	55.5 (15.5;19-91)	0.970	**47.2 (14.3;26-70)**	**56.4 (15.0;19-91)**	**0.010**
Partnership, n (%)							
Single[b]	72 (35.1)	14 (35.0)	58 (35.2)	0.990	7 (35.0)	65 (35.1)	0.990
Partner[c]	133 (64.9)	26 (65.0)	107 (64.9)		13 (65.0)	120 (64.9)	
BSA, mean (SD; min-max)	6.5 (13.4; 0-80)	**8.0 (13.6; 0-70)**	**6.2 (13.4; 0-80)**	**0.030**	**9.6 (11.3; 0-50)**	**6.2 (13.6; 0-80)**	**0.010**
DLQI, mean (SD; min-max)	4.6 (5.6; 0-25)	**6.8 (6.8;0-25)**	**4.0 (5.2;0-24)**	**0.010**	**10.8 (8.0;0-25)**	**3.9 (4.9; 0-24)**	**0.010**
Disease duration (yrs), mean (SD; min-max)	23.2 (15.4; 1-70)	26.0 (14.9; 2-55)	22.3 (15.5; 1-70)	0.140	19.1 (13.4; 3-55)	23.5 (15.6; 1-70)	0.260
Comorbidities, n (%)							
Psoriatic arthritis	92 (44.9)	21 (52.5)	71 (43.0)	0.280	10 (50.0)	82 (44.3)	0.628
Arterial hypertension	87 (42.4)	17 (42.5)	70 (42.4)	0.993	**4 (20.0)**	**83 (44.9)**	**0.033**
Cardiovascular disease	26 (12.7)	7 (17.5)	19 (11.5)	0.308	1 (5.0)	25 (13.5)	0.277
Diabetes mellitus	31 (12.1)	6 (15.0)	25 (15.2)	0.981	1 (5.0)	30 (16.2)	0.184
Hyperlipidaemia	46 (22.4)	10 (25.0)	36 (21.8)	0.675	4 (20.0)	42 (22.7)	0.783
Depression	31 (15.1)	**13 (32.5)**	**18 (10.9)**	**0.001**	5 (25.0)	26 (14.1)	0.194
Anxiety disorder	13 (6.3)	**6 (15.0)**	**7 (4.2)**	**0.012**	3 (15.0)	10 (5.4)	0.094
Allergies	55 (26.8)	**16 (40.0)**	**39 (23.6)**	**0.036**	8 (40.0)	47 (25.4)	0.162
Chronic bronchitis / asthma	25 (12.2)	4 (10.0)	21 (12.7)	0.636	2 (10.0)	23 (12.4)	0.752
Liver disease	5 (2.4)	1 (2.5)	4 (2.4)	0.978	1 (5.0)	4 (2.2)	0.434
Renal failure	4 (2.0)	2 (5.0)	2 (1.2)	0.120	1 (5.0)	3 (1.6)	0.299
Hypo- or hyperthyroidism	28 (13.7)	7 (17.5)	21 (12.7)	0.430	3 (15.0)	25 (13.5)	0.854
Neoplasia	5 (2.4)	**3 (7.5)**	**2 (1.2)**	**0.021**	0 (0.0)	5 (2.7)	0.457
Other comorbidities[d]	30 (14.6)	9 (22.5)	21 (12.7)	0.117	4 (20.0)	26 (14.1)	0.475
No comorbidity	45 (22.0)	6 (15.0)	39 (23.6)	0.236	5 (25.0)	40 (21.6)	0.729
Number of comorbidities, mean (SD; min-max)	1.7 (1.5; 0-7)	**2.3 (1.8;0-7)**	**1.6 (1.5;0-6)**	**0.017**	1.7 (1.5;0-4)	1.8 (1.6;0-7)	0.870
Subjective impairment of general health state[e], mean (SD; min-max)	1.5 (1.1; 0-4)	**1.8 (1.1;0-4)**	**1.4 (1.1;0-4)**	**0.022**	**2.0 (1.3;0-4)**	**1.4 (1.1;0-4)**	**0.042**
Self-perceived susceptibility to infections, n (%)							
No	175 (85.4)	**28 (70.0)**	**147 (89.1)**	**0.002**	**14 (70.0)**	**161 (87.0)**	**0.041**
Yes	30 (14.6)	**12 (30.0)**	**18 (10.9)**		**6 (30.0)**	**24 (13.0)**	

[a] *Differences were tested for significance with Chi-square test for binary and categorical variables and Mann-Whitney-U tests for linear variables except age, where t-test was used.* [b] *No partner, divorced or widowed.* [c] *In partnership or married.* [d] *Several participants reported more than one "other comorbidity".* [e] *Assessed on a 5-point scale (from 0 = none to 4 = very much). BSA: Body Surface Area; DLQI: Dermatology Life Quality Index.; max: maximum; min: minimum; n: number; SD: standard deviation; yrs: years.*

followed by topical therapy (59.5%), non-biological systemic therapy (20%) and phototherapy (6.8%). The mean treatment duration was 40.2 months, and mean treatment satisfaction was 4.2 on a 5-point scale. Shorter treatment duration was found in those who changed therapy compared to those who did not change therapy (*p* = 0.023) (*table 3*).

Impairment by the COVID-19 pandemic
Assessed on a 5-point scale from 0 (none) to 4 (very high), the mean level of worry about health because of the pandemic was 1.9 and mean level of concern about continuing the current psoriasis therapy was 0.5 (*table 4*). Mean fear of more severe COVID-19 due to the current

psoriasis therapy was 1.1 and the probability of reducing psoriasis-related physician appointments was 1.0. Participants were most afraid of SARS-CoV-2 infections acquired from other patients (31.2%), followed by infections during travel to appointments (10.7%) and infections transmitted from medical staff (8.3%). Aggravation of psoriasis was reported by 14.2% and an improvement by 3.4% during the pandemic. The vast majority of aggravations (93.1%) were attributed to increased stress. SARS-CoV-2 infections were not detected in any of the participants, but in four household members and 19 close acquaintances.
Participants who missed appointments or changed their therapy were more worried about their own health because of the pandemic (*p* = 0.010 and *p* = 0.002), more concerned

Table 3. Treatment-related characteristics of all participants and subgroups with changes in appointments and/or therapy.

Characteristic	All	Missed appointment			Therapy change		
	n = 205	Yes, n = 40	No, n = 165	p^c	Yes, n = 20	No, n = 185	p^c
Current treatment[a], n (%)							
Topical therapy	122 (59.5)	26 (65.0)	96 (58.2)	0.431	15 (75.0)	107 (57.8)	0.137
Phototherapy	14 (6.8)	3 (7.5)	11 (6.7)	0.851	1 (5.0)	13 (7.0)	0.733
Non-biological systemic therapy	41 (20.0)	5 (12.5)	36 (21.8)	0.186	1 (5.0)	40 (21.6)	0.078
Biologicals	146 (71.2)	32 (80.0)	114 (69.1)	0.172	18 (90.0)	128 (69.2)	0.051
TNF-α antagonist	46 (22.4)	11 (27.5)	35 (21.2)	0.898	6 (30.0)	40 (21.6)	0.818
IL-17 inhibitor	50 (24.4)	10 (25.0)	40 (24.2)		5 (25.0)	45 (24.3)	
IL-(12)/23 inhibitor	50 (24.4)	11 (27.5)	39 (23.6)		7 (35.0)	43 (23.2)	
Treatment duration (month), mean (SD; min-max)	40.2 (45.2; 0-222)	31.2 (33.3;2-132)	42.1 (42.3;0-222)	0.340	**20.1 (30.0;2-120)**	**42.2 (46.0;0-222)**	**0.023**
Treatment satisfaction[b], mean (SD; min-max)	4.2 (1.0; 1-5)	4.1 (1.0;2-5)	4.2 (1.0;1-5)	0.290	3.7 (1.2;1-5)	4.2 (0.9;1-5)	0.070

[a] Multiple answers were permitted. For a list of changed therapies see table 1. [b] Assessed on a 5- point scale from 1 = very dissatisfied to 5 = very satisfied.
[c] Differences were tested for significance with Chi-square test for categorical variables and Mann-Whitney-U tests for linear variables. IL: interleukin; max: maximum; min: minimum; n: number; SD: standard deviation; TNF-α: tumour necrosis factor-α.

about continuing their current psoriasis therapy ($p = 0.002$; $p < 0.001$), more afraid of a severe course of COVID-19 due to the current psoriasis therapy ($p = 0.001$ and $n= 0.002$) and more likely to reduce future psoriasis-related appointments because of the pandemic ($p < 0.001$ and $p < 0.001$) than their counterparts (*table 4*). Changes in psoriasis severity were more frequent in those who missed a consultation ($p = 0.001$) and altered treatment ($p < 0.001$). SARS-CoV-2 infections among close acquaintances and personal protection with face masks were more common among participants who changed their treatment (*table 4*). Decreased social contact was higher in those who missed a consultation ($p = 0.049$) and altered treatment ($p = 0.010$).

Determinants identified in multivariate logistic regression models

Logistic regression analysis confirmed the positive association between DLQI (OR 1.07, $p = 0.044$) and missed appointments. A higher number of comorbidities (OR 1.33, $p = 0.024$) was associated with a greater likelihood of missed appointments (*table 5*). While those with older age were less likely to change therapy (OR 0.95, $p = 0.026$), higher DLQI (OR 1.18, p < 0.001) and greater worry about one's own health (OR 1.70, $p = 0.027$) were associated with therapy change.

Discussion

In contrast to other countries more severely affected by the COVID-19 pandemic, Germany was not threatened by a collapse in the healthcare system during its first wave. This enabled us to continue psoriasis care under extensive preventive measures at our department [19]. In accordance with guidelines and recommendations of German and international societies [11-16], systemic psoriasis therapy was continued for the vast majority of patients after risk-benefit consideration. Moreover, we continued psoriasis clinics under comprehensive precautions, including hygiene and disinfection measures, safety distancing, reduction of the number of patients in waiting areas and obligatory face masks for patients and staff. Our patients were counselled in face-to-face visits scheduled according to individual needs and by telemedicine (*i.e.* by phone and e-mail), as recommended [11-14]. Fortunately, no SARS-CoV-2 infection has occurred in our psoriasis clinic so far.

Treatment changes during the pandemic

Non-adherence to treatment was already common among psoriasis patients before the pandemic [20, 21]. During the pandemic, this can be expected to further decrease due to fear of continuing immunosuppressive drugs and acquiring nosocomial SARS-CoV-2 infections during physicians' appointments. The rate of treatment alterations in our cohort was <10%, and 40% of the changes were recommended by physicians. However, only half of our participants consulted their physician before changing therapy. In comparison, studies from countries more severely affected by the pandemic reported higher rates of treatment discontinuation. In a French cohort comprising 1,418 patients with psoriasis, 22.4% of the patients on non-biological systemic therapy and 13.8% on biologicals discontinued treatment [22]. According to a retrospective Spanish study, 26.7% of 146 patients stopped treatment with biologicals or small molecules, most frequently upon the recommendation of dermatologists [23]. Even though Greece was not a COVID-19 hot spot, 23.6% of 237 Greek patients with psoriasis changed their systemic medication due to fear of SARS-CoV-2 infection [24].
Conversely, several studies found similar or even lower discontinuation rates than ours. According to a Czech study, none of the patients on biologicals ($n = 117$) and only 4.3% (2/47) on conventional immunosuppressants discontinued therapy during the pandemic [25]. A Danish survey on patients with atopic dermatitis ($n= 68$) and psoriasis ($n = 233$) found a discontinuation rate of 7.3% [26]. In two retrospective investigations on patient-driven

Table 4. Impairment due to the COVID-19 pandemic: changes in appointments and/or therapy.

Characteristic	All	Missed appointment			Therapy change		
	n= 205	Yes, n = 40	No, n = 165	p[a]	Yes, n = 20	No, n = 185	p[a]
Level of worry about the one's own health because of the pandemic[b], mean (SD; min-max)	1.9 (1.3; 0-4)	**2.4 (1.3; 0-4)**	**1.8 (1.3; 0-4)**	0.010	**2.8 (1.1; 1-4)**	**1.8 (1.3; 0-4)**	0.002
Concerns about continuing the psoriasis therapy during the pandemic[b], mean (SD; min-max)	0.5 (1.0; 0-4)	**1.0 (1.4;0-4)**	**0.4 (0.8;0-4)**	0.002	**1.4 (1.5;0-4)**	**0.4 (0.9;0-4)**	<0.001
Fear of a more severe course of COVID-19 because of the psoriasis therapy[b], mean (SD; min-max)	1.1 (1.2; 0-4)	**1.9 (1.5;0-4)**	**0.9 (1.1;0-4)**	0.001	**2.2 (1.6;0-4)**	**1.0 (1.1;0-4)**	0.002
Probability of reducing the frequency of future psoriasis-related appointments with physicians because of the pandemic[c], mean (SD; min-max)	1.0 (1.3; 0-4)	**2.3 (1.4;0-4)**	**0.7 (1.0;0-4)**	<0.001	**2.1 (1.5;0-4)**	**0.9 (1.2;0-4)**	<0.001
Feared source of infection with SARS-CoV-2[d], n (%)							
Medical staff	17 (8.3)	**9 (22.5)**	**8 (4.9)**	<0.001	**4 (20.0)**	**13 (7.0)**	0.046
Other patients	64 (31.2)	**27 (67.5)**	**37 (22.4)**	<0.001	**13 (65.0)**	**51 (27.6)**	0.001
On the way to the appointment	22 (10.7)	**9 (22.5)**	**13 (7.9)**	0.007	4 (20.0)	18 (9.7)	0.159
Change in psoriasis severity during the pandemic, n (%)							
No change	169 (82.4)	**25 (62.5)**	**144 (87.3)**	0.001	**10 (50.0)**	**159 (86.0)**	<0.001
Improvement	7 (3.4)	**3 (7.5)**	**4 (2.4)**		**0 (0.0)**	**7 (3.8)**	
Aggravation	29 (14.2)	**12 (30.0)**	**17 (10.3)**		**10 (50.0)**	**19 (10.3)**	
Confirmed SARS-CoV-2 infection, n (%)							
Participants	0 (0)	0 (0.0)	0 (0.0)	0.384	**0 (0.0)**	**0 (0.0)**	0.005
Household members	4 (2.0)	1 (2.5)	3 (1.8)		**0 (0.0)**	**4 (2.2)**	
Close acquaintances	19 (9.3)	6 (15.0)	13 (7.9)		**6 (30.0)**	**13 (7.0)**	
Decrease in social contact[b], mean (SD; min-max)	2.9 (1.3; 0-4)	**3.2 (1.3; 0-4)**	**2.8 (1.3; 0-4)**	0.049	**3.5 (1.1; 0-4)**	**2.8 (1.3; 0-4)**	0.010
Face mask use, n (%)							
No mask	55 (26.8)	6 (15.0)	49 (29.7)	0.136	**3 (15.0)**	**52 (28.1)**	0.039
Yes, simple mask	130 (63.4)	29 (72.5)	101 (61.2)		**12 (60.0)**	**118 (63.8)**	
Yes, FFP2/FFP3 mask	20 (9.8)	5 (12.5)	15 (9.1)		**5 (25.0)**	**15 (8.1)**	

[a] *Differences were tested for significance with Chi-square test for categorical variables and Mann-Whitney-U tests for linear variables.* [b] *Assessed on a 5-point scale from 0 = none to 4 = very much.* [c] *Assessed on a 5-point scale from 0 = in no case to 4 = definitely.* [d] *Feared source of infection regarding less psoriasis-related appointments with physicians in the future. Multiple answers were permitted. Max: maximum; min: minimum; n: number; SD: standard deviation.*

Table 5. Logistic regression models including potential determinants for missed appointment and therapy change.

Characteristic	Missed appointment[a]			Therapy change[a]		
	OR[a]	95% CI	p	OR[a]	95% CI	p
Male[b]	1.15	0.55–2.38	0.711	0.38	0.12–1.17	0.092
Age	0.99	0.96–1.02	0.539	**0.95**	**0.91–0.99**	**0.026**
DLQI	**1.07**	**1.00–1.14**	**0.044**	**1.18**	**1.08–1.28**	**<0.001**
BSA	1.00	0.97–1.03	0.889	0.98	0.94–1.02	0.422
Number of comorbidities	**1.33**	**1.04–1.71**	**0.024**	0.98	0.65–1.47	0.910
Systemic therapy[c]	0.89	0.30–2.69	0.842	0.29	0.03–2.66	0.273
Worry about one's own health	1.25	0.93–1.68	0.140	**1.70**	**1.06–2.73**	**0.027**

[a] *Dependent variable: missed appointment or therapy change, respectively. All independent variables were integrated simultaneously into the model. Reference categories:* [b] *female,* [c] *no systemic therapy. Other variables were incorporated as linear values. Significant findings are highlighted in bold. BSA: Body Surface Area; CI: confidence interval; DLQI: Dermatology Life Quality Index; OR: Odds Ratio.*

discontinuation from Canada, only 0.5% of the patients on biologicals (7/1390) [27] and 0% (0/188) on apremilast [28] interrupted therapy. A phone survey in an Italian region severely affected by the pandemic revealed a surprisingly low discontinuation rate of only 5.2% (27/515) among biological users [29]. Discrepancies between discontinuation rates may be explained by national or regional differences in the number of SARS-CoV-2 infections, dynamics of the pandemic, resources of health care systems, support provided by medical caregivers, lockdown regulations, legal requirements, reporting in the media and socio-cultural habits, as well as by differences in the study design.

Missed appointments

Almost 20% of our responders missed at least one psoriasis-related appointment, most frequently on their own request due to fear of SARS-CoV-2 infection. To continue psoriasis care that conforms to guidelines, considering these concerns, dermatologists should implement modalities such as teleconsultations and digital prescriptions when feasible [16].

Impact factors associated with treatment changes and missed appointments

Patient characteristics

Numerous patient- and health-related determinants on change in treatment and/or appointments were identified in our cohort. Younger participants were more likely to change therapy, although older age is a known risk factor for severe COVID-19 courses. However, older patients were shown to be more compliant with treatment than younger ones in previous studies, which might explain this observation [20, 30].

Furthermore, greater impairment of general health, susceptibility to infections, a higher number of comorbidities and particular diseases (depression, anxiety disorder, allergies and neoplasia) were associated with a higher probability of changing therapy and/or missing appointments. We assume that all of these factors were associated with greater fear of a SARS-CoV-2 infection. Neoplasias [31] as well as several psoriasis-associated comorbidities, such as cardiovascular diseases, diabetes and metabolic syndrome [32], are known to contribute to an increased risk of severe COVID-19 courses. Depression and anxiety disorders likely potentiate the fear of SARS-CoV2 infection. Interestingly, some studies suggest that self-reported allergies are linked to an anxious personality [33], which could explain the observation that allergies were associated with a higher probability of missed appointments.

Disease and treatment characteristics

Participants who changed therapy or missed appointments had a higher BSA and DLQI than others and experienced aggravation of psoriasis more often in our study. According to an Italian telephone survey conducted in May 2020, 27.9% of 226 patients described worsening of the disease, with a correlation to drug withdrawal and impairment of psychological status [34]. Clearly, flares of psoriasis may be a consequence of interrupted treatments and/or reduced appointments. In addition, psychological distress due to the pandemic may contribute to worsening of the psoriasis and impairment of life quality. Patients suffering from stress were reported to experience psoriasis as a greater burden and to overestimate its severity [35].

Furthermore, shorter treatment duration correlated with a higher likelihood of changing therapy, possibly because patients with a shorter treatment experience are less confident with their therapy.

Patient needs during the pandemic

Our results highlight the necessity to address individual needs, concerns and fears of psoriasis patients during the pandemic in order to identify obstacles to compliance and to find individual solutions. Physicians need to counsel patients even more intensively than usual in these times regarding benefits and risks of systemic treatments. While there was uncertainty about the influence of systemic antipsoriatic drugs on COVID-19 at the beginning of the pandemic, recent studies have not shown an increased risk of hospitalization or death due to COVID-19 in psoriasis patients with systemic therapies [32, 36]. Inhibition of TNF-α and IL-17 has even been suggested to be protective against the cytokine storm in critically ill COVID-19 patients [37-39].

Limitations

Limitations of our study are the monocentric setting, the contact method and the patient-reported nature of the survey. Our cohort merely included patients from a German tertiary care centre who were contacted by ordinary mail. Only 36.1% of questionnaires were returned, possibly resulting in selection bias. However, the sex distribution of those who were contacted and those who participated in our study was similar (41.7% vs. 46.8% females), although, in general, females are more prone to participate in surveys. It is conceivable that comorbidities were under- or overestimated because they were self-reported by the participants. Depression was not validated by a professional psychological scale or score. Treatment satisfaction, general health, fear of SARS-CoV-2 infection and other COVID-19-related items were assessed with 5-point scales and not with more specific scores in order to limit the length of the questionnaire.

Discontinuation rates and missed appointments may have been affected by the treating physician and institution. Furthermore, we did not investigate how information from media, patient organizations or internet platforms influenced changes in treatment and appointments.

Evidently, discontinuation or cancellation rates may vary dependent on the time point of data collection and the dynamics of the pandemic. Our survey was conducted immediately after the first wave of COVID-19 in Germany, during which less than 200,000 persons were tested positive for SARS-CoV-2. Fortunately, none of our participants suffered from COVID-19 during the first wave. Thus, we were not able to take psoriasis patients infected with COVID-19 into account in our study.

Conclusions

In this study, we identified several patient-related key drivers of changes in psoriasis care during the COVID-19 pandemic, in particular, health-related characteristics and a high level of concern and anxiety due to the pandemic. Changes in appointments and treatment were associated with higher psoriasis severity scores and more frequent disease aggravation. Clearly, our results should be verified in a larger and more diverse sample and in a multicentre setting before general conclusions can be drawn. However, we recommend contacting patients who miss appointments, to enquire about their well-being, disease activity, compliance with treatment, reasons for missed appointments and/or treatment changes, as well as special needs, wishes and concerns during the pandemic. Tailoring psoriasis care to individual requirements is even more crucial during the pandemic to protect physical and mental well-being of patients.

Supplementary data

Supplementary data associated with this article can be found, in the online version, at 10.1684/ejd.2021.4016.
File S1: Questionnaire.
Table S1: Treatment changes due to the pandemic.

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