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Original article

Baseline factors associated with self-reported disease flares following COVID-19 vaccination among adults with systemic rheumatic disease: results from the COVID-19 global rheumatology alliance vaccine survey

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Abstract

Objective. To examine the frequency of, and risk factors for, disease flare following COVID-19 vaccination in patients with systemic rheumatic disease (SRD).

Methods. An international study was conducted from 2 April to 16 August 2021, using an online survey of 5619 adults with SRD for adverse events following COVID-19 vaccination, including flares of disease requiring a change in treatment. We examined risk factors identified *a priori* based on published associations with SRD activity and SARS-CoV-2 severity, including demographics, SRD type, comorbidities, vaccine type, cessation of immunosuppressive medications around vaccination and history of reactions to non-COVID-19 vaccines, using multivariable logistic regression.

Results. Flares requiring a change in treatment following COVID-19 vaccination were reported by 4.9% of patients. Compared with rheumatoid arthritis, certain SRD, including systemic lupus erythematosus (OR 1.51, 95% CI 1.03, 2.20), psoriatic arthritis (OR 1.95, 95% CI 1.20, 3.18) and polymyalgia rheumatica (OR 1.94, 95% CI 1.08, 2.48) were associated with higher odds of flare, while idiopathic inflammatory myopathies were associated with lower odds for flare (OR 0.54, 95% CI 0.31–0.96). The Oxford-AstraZeneca vaccine was associated with higher odds of flare relative to the Pfizer-BioNTech vaccine (OR 1.44, 95% CI 1.07, 1.95), as were a prior reaction to a non-COVID-19 vaccine (OR 2.50, 95% CI 1.76, 3.54) and female sex (OR 2.71, 95% CI 1.55, 4.72).

Conclusion. SRD flares requiring changes in treatment following COVID-19 vaccination were uncommon in this large international study. Several potential risk factors, as well as differences by disease type, warrant further examination in prospective cohorts.

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Rheumatology key messages

- Disease flare is uncommonly reported following COVID-19 vaccination in patients with systemic rheumatic diseases.
- Several factors were associated with disease flare following COVID-19 vaccination, but need confirmation.

Introduction

With billions of individuals worldwide now immunized with a least one dose of a COVID-19 vaccine, it is apparent that observational data support initial trial evidence, suggesting that COVID-19 vaccines are safe and effective [1]. Although the initial vaccine trials did not include patients with systemic rheumatic disease (SRD), vaccination is especially important for this population due to an increased risk for poor outcomes from SARS-CoV-2 [2]. Increased disease activity or 'disease flares' have also been reported following vaccination against SARS-CoV-2 and may reduce willingness to be vaccinated among patients with SRD [3–7]. SRD flares have been uncommonly reported following immunization with other vaccines, including influenza and herpes zoster [8, 9].

Several plausible risk factors for SRD flares should be considered in relation to flare after vaccination. First, comorbidities and demographic factors, which are also risk factors for developing RA and other SRDs or are associated with disease activity, may be related to flares after vaccination. Beyond baseline characteristics, cessation of SRD therapies could contribute to disease flares and have been observed in studies of patients who have temporarily discontinued methotrexate following influenza and pneumococcal vaccination [10]. Variable immunogenicity of the different vaccines may be a risk factor for disease flare, and rare reports of autoimmune sequelae, such as Guillain-Barre syndrome and immune thrombocytopenia, have been observed following Janssen/Johnson & Johnson and Oxford-AstraZeneca vaccines, respectively [11].

We sought to examine the frequency of flares in patients with SRD following COVID-19 vaccines and to examine risk factors for flare following vaccination.

Patients and methods

Study design and population

This retrospective study examined self-reported flare requiring a change in treatment following COVID vaccination in an international sample of SRD patients. Data were collected using the COVID-19 Global Rheumatology Alliance (GRA) vaccine survey of adults with SRD, an online questionnaire available in multiple languages administered using the Qualtrics platform and promoted through patient support groups and social media [3]. Informed consent was waived, as the study was determined exempt by the Boston Children's Hospital Institutional Review Board. The data underlying this article were provided by the COVID-19 Global Rheumatology Alliance; data will be shared on request to the corresponding author with permission of the COVID-19 Global Rheumatology Alliance.

A total of 11 032 participants responded to the survey from 2 April 2 to 16 August 2021. Of these, 2960 participants were excluded for not completing the survey or not specifying a SRD diagnosis, along with 580 participants who only reported a diagnosis of osteoarthritis or fibromyalgia. In the remaining sample, 1544 participants were excluded for being unvaccinated, and 329 were excluded for missing data on at least one of the model covariates.

Data collection and self-reported flare outcome

The online survey is available at the COVID-19 GRA website (https://rheum-covid.org) (see COVID-19 Vax Survey) [12]. Participants were asked to report their type and year of SRD diagnosis (Supplementary Table S1, available at *Rheumatology* online); individuals reporting multiple diseases were classified based on the hierarchy of diseases established by Strangfeld *et al.* [13]. Participants who received at least one dose of a COVID-19 vaccine were asked whether they had any serious reaction to the COVID-19 vaccine. Serious reactions were defined as lasting for at least two days and occurring within two months of receiving the vaccination. The primary outcome of interest was a self-reported flare of an existing SRD requiring a change in treatment (e.g. increasing dosages and/or adding new medications) for the SRD.

Statistical analyses

We first examined the frequency of disease flares requiring a change in treatment following COVID-19 vaccination overall and by SRD type, demographic factors [age, gender, race/ethnicity (non-Hispanic white, non-white)], WHO region, and potential risk factors, including comorbid and other health conditions (Supplementary Table S2, available at *Rheumatology* online), smoking status, vaccine type, history of a serious reaction to a

non-COVID vaccine, discontinuation of immunosuppressive medications before or after receiving COVID-19 vaccine, and prior SARS-CoV-2 infection. Comorbidities were grouped to identify patients with either cardiopulmonary or immunodeficiency conditions, as well as the subset with obstructive lung diseases [asthma, chronic bronchitis, emphysema, or chronic obstructive pulmonary disease (COPD)] and obesity (BMI $\geq$30 mg/m^2).

We then considered the association of disease flare with SRD type and covariates in a mutually adjusted logistic regression model used to calculate odds ratios (OR) and 95% CI. As WHO region was strongly correlated with COVID vaccine type, WHO region was not included in the model, as the vaccine type was expected to impact immune response. We considered both individual comorbidities, as well as those grouped by affected organ, and determined that obstructive lung disease as a disease group and BMI (obese *vs* non-obese) best contributed to model fit. The final model included SRD type, obstructive lung diseases, BMI, smoking status, type of COVID-19 vaccine, serious reaction to a prior non-COVID vaccine, cessation of medications at the time of vaccination, age, sex and race/ethnicity.

Results

The final analytical sample consisted of 5619 participants with SRD who received at least one dose of a COVID-19 vaccine (Supplementary Fig. S1 for flow diagram, available at *Rheumatology* online). Participant characteristics and potential risk factors for flare are detailed in Table 1. The median age of participants was 55.5 years, and the majority were female and white. Rheumatoid arthritis was the most frequent SRD among participants ($n = 1701$, 30.3%), followed by idiopathic inflammatory myopathies (824, 14.7%), systemic lupus erythematosus (791, 14.1%), Sjögren's syndrome (540, 9.6%), psoriatic arthritis (304, 5.4%), ankylosing spondylitis (291, 5.2%), polymyalgia rheumatica (197, 3.5%), vasculitis (163, 2.9%) and systemic sclerosis (135, 2.5%). The majority of subjects received an mRNA vaccine, and 65.8% did not hold SRD medications at the time of vaccination.

Disease flares requiring changes in treatment following COVID-19 vaccination were reported by 4.9% of respondents. Flares were more commonly reported in younger respondents (median age 52.4 *vs* 55.5 years) and in females (5.4% *vs* 1.7%) and were less prevalent in Hispanic or Latin American compared with white patients (2.5% *vs* 5.2%) (Table 1). The prevalence of flare was higher among those with lupus (6.7%), psoriatic arthritis (7.9%) and polymyalgia rheumatica (8.1%). Respondents with myositis (1.9%) and systemic sclerosis (1.5%) reported the lowest flare prevalence. The prevalence of flare was somewhat higher among patients with a history of asthma, emphysema, chronic bronchitis or COPD (6.1% *vs* 4.6%), and in those who received the Oxford-AstraZeneca vaccine compared with than Pfizer-BioNTech and Moderna vaccines (6.3% *vs* 4.5% and 5.1%, respectively). Flares were more frequently seen in respondents who reported serious reactions to other non-COVID-19 vaccines in the past (11.2% *vs* 4.4%). The prevalence of flares following COVID-19 vaccination did not appear to differ by the other factors examined, including among those who stopped medications at the time of vaccination or reported a history of COVID-19 infection (Table 1).

In a multivariable logistic regression model examining risk factors for a disease flare requiring a change in treatment (Table 2), the odds of experiencing flare following COVID-19 vaccine were highest among females (OR 2.71; 1.55, 4.72). Compared with respondents with rheumatoid arthritis, odds of flare were elevated for systemic lupus erythematosus (OR 1.51, 95% CI 1.03, 2.20), psoriatic arthritis (OR 1.95, 95% CI 1.20, 3.18) and polymyalgia rheumatica (OR 1.94, 95% CI 1.08, 2.48) and lower among those with inflammatory myopathies (OR 0.54, 95% CI 0.31, 0.96). Other factors that were independently associated with disease flare included receiving the Oxford AstraZeneca vaccine (OR 1.44, 95% CI 1.07, 1.95) compared with the Pfizer-BioNTech vaccine, and having a prior serious reaction to non-COVID-19 vaccine (OR 2.50, 95% CI 1.76, 3.54) compared with no prior serious reaction to a non-COVID-19 vaccine. Age, race/ethnicity, obstructive lung diseases (asthma, emphysema, chronic bronchitis or COPD), smoking, obesity and cessation of medications at the time of vaccination were not associated with disease flare requiring change in treatment in this sample.

Discussion

This large international study of COVID-19 vaccination in 5691 patients with SRD enabled investigation of risk factors for disease flare among a diverse sample of diagnoses and following a variety of COVID-19 vaccines. We showed that SRD flares requiring changes in SRD treatments following COVID-19 vaccines were uncommon, occurring in only 4.9% of survey respondents. This broadly reflects results from prior studies reporting SRD flares in adults after COVID-19 vaccination, which range from 1.5–15% [4–7, 14, 15]. The lowest estimates to date include two international studies in which 1.5% of 4498 patients with rheumatic diseases and 2.4% of 696 patients with systemic lupus erythematosus reported a disease flare requiring increased treatment [4, 7], while a study of 1500 autoimmune rheumatic disease patients in China reported 3.5% of patients developed a disease flare requiring treatment escalation [6]. Other studies have observed higher frequencies of disease flares requiring changes in treatment, including 11% in a study of 1377 patients with SRD receiving mRNA vaccines [5], 5% in a study of 594 patients that also included people with multiple sclerosis [13] and 15% in a study of >1000 patients with SRD in New York City [15]. These variations are likely related to differences in the composition of study populations, vaccine exposure and flare

Table 1 Characteristics and clinical features in rheumatic disease patients receiving COVID-19 vaccines by subsequent disease flare

	Overall (*n* = 5619) *n* (%)	Flare (*n* = 274) *n* (%)	No flare (*n* = 5345) *n* (%)	Prevalence of flare %
Age at enrolment, years (median)	55.5 [44.4, 65.4]	52.4 [44.3, 61.5]	55.5 [44.4, 65.5]	4.9
Sex at birth				
Male	802 (14.3)	14 (5.1)	788 (14.7)	1.7
Female	4817 (85.7)	260 (94.9)	4557 (85.3)	5.4
Race/ethnicity				
White	4602 (81.9)	237 (86.5)	4365 (81.7)	5.2
Hispanic, Latinx or Latin American	399 (7.1)	10 (3.6)	389 (7.3)	2.5
Asian (South, East Asia)	109 (1.9)	6 (2.2)	103 (1.9)	5.5
Middle Eastern or North African	87 (1.5)	5 (1.8)	82 (1.5)	5.7
Black	78 (1.4)	4 (1.5)	74 (1.4)	5.1
American Indian/Alaska Native/ Aboriginal/Indigenous/First Nations	16 (0.3)	0 (0.0)	16 (0.3)	0.0
Other[a]	328 (5.8)	12 (4.4)	316 (5.9)	3.7
Systemic rheumatic disease				
RA	1701 (30.3)	77 (28.1)	1624 (30.4)	4.5
Idiopathic inflammatory myopathies	824 (14.7)	16 (5.8)	808 (15.1)	1.9
SLE	791 (14.1)	53 (19.3)	738 (13.8)	6.7
SS	540 (9.6)	22 (8.0)	518 (9.7)	4.1
PsA	304 (5.4)	24 (8.8)	280 (5.2)	7.9
AS	291 (5.2)	17 (6.2)	274 (5.1)	5.8
PMR	197 (3.5)	16 (5.8)	181 (3.4)	8.1
Vasculitis	163 (2.9)	10 (3.6)	153 (2.9)	6.1
SSc	135 (2.4)	2 (0.7)	133 (2.5)	1.5
IBD	118 (2.1)	5 (1.8)	113 (2.1)	4.2
GCA	67 (1.2)	3 (1.1)	64 (1.2)	4.5
Psoriasis	67 (1.2)	4 (1.5)	63 (1.2)	6.0
Asthma, chronic bronchitis, emphysema or COPD				
No	4689 (83.5)	217 (79.2)	4472 (83.7)	4.6
Yes	930 (16.5)	57 (20.8)	873 (16.3)	6.1
BMI				
Non-obese (BMI $<30\,kg/m^2$)	4310 (76.7)	208 (75.9)	4102 (76.7)	4.8
Obese (BMI $\geq 30\,kg/m^2$)	1309 (23.3)	66 (24.1)	1243 (23.3)	5.0
Smoking status				
Never smoker	3456 (61.5)	180 (65.7)	3276 (61.3)	5.2
Past smoker	1792 (31.9)	74 (27.0)	1718 (32.1)	4.1
Current smoker	371 (6.6)	20 (7.3)	351 (6.6)	5.4
COVID-19 vaccine				
Pfizer-BioNTech	3028 (53.9)	137 (50.0)	2891 (54.1)	4.5
Moderna	1035 (18.4)	53 (19.3)	982 (18.4)	5.1
Oxford-AstraZeneca	1200 (21.4)	76 (27.7)	1124 (21.0)	6.3
Other[b]	356 (6.3)	8 (2.9)	348 (6.5)	2.2
Serious reaction to a non-COVID-19 vaccine				
No	5225 (93.0)	230 (83.9)	4995 (93.5)	4.4
Yes	394 (7.0)	44 (16.1)	350 (6.5)	11.2
Withheld SRD medications at time of vaccine				
No	3700 (65.8)	183 (66.8)	3517 (65.8)	5.0
Yes	1498 (26.7)	79 (28.8)	1419 (26.5)	5.3
No medications	421 (7.5)	12 (4.4)	409 (7.7)	2.8
Comorbid disease type				
Cardiopulmonary	2707 (48.2)	134 (48.9)	2573 (48.1)	5.0
Immunodeficiency	454 (8.1)	21 (7.7)	433 (8.1)	4.6
No cardiopulmonary, no immunodeficiency	2458 (43.7)	119 (43.4)	2339 (43.8)	4.8
WHO region				
Region of the Americas	2999 (53.4)	127 (46.4)	2872 (53.7)	4.2
European Region	2414 (43.0)	140 (51.1)	2274 (42.5)	5.8
Other Region	206 (3.7)	7 (2.5)	199 (3.7)	3.4

(continued)

TABLE 1 Continued

	Overall (n = 5619) n (%)	Flare (n = 274) n (%)	No flare (n = 5345) n (%)	Prevalence of flare %
Prior SARS-CoV-2 infection				
Yes	570 (10.1)	26 (9.5)	544 (10.2)	4.6
No	4841 (86.2)	236 (86.1)	4605 (86.2)	4.9
Not sure	208 (3.7)	12 (4.4)	196 (3.7)	5.8

SRDs reported by >1% of participants shown. A full listing of systemic rheumatic diseases is in Supplementary Table 1 and full listing of comorbid diseases by type is in Supplementary Table S2, both available at *Rheumatology* online. [a]Other participants include Pacific Islander, other, prefer not to say, and do not know/unsure. [b]Other vaccines include Sinovac/Sinopharm, Janssen/Johnson & Johnson, Sputnik V, Cansino, Covishield, Verocell and Novavax. COPD: chronic obstructive pulmonary disease; SRD: systemic rheumatic disease.

definitions across studies. Notably, the frequency of disease flare following COVID-19 vaccines in the present and other published studies are within range of the background disease flare rate of 7% from population-based data in France from 1200 patients with SRD (not including patients with rheumatoid arthritis) over a 3-month period in 2020, prior to vaccine availability [16].

Our study has identified several novel characteristics as potential risk factors for disease flare following COVID-19 vaccination, including the observation that patients with systemic lupus erythematosus, psoriatic arthritis or polymyalgia rheumatica were more likely to report a disease flare requiring change in treatment following COVID-19 vaccination as compared with those with rheumatoid arthritis, while patients with inflammatory myopathies were significantly less likely to report a disease flare. These findings were independent of demographic differences and other patient characteristics. A higher frequency of flare in patients with lupus relative to patients with rheumatoid arthritis following inactivated COVID-19 vaccines was also seen in the Chinese study [6]. In the EULAR COVAX registry, patients with inflammatory joint diseases experienced a slightly higher prevalence of flare compared with connective tissue diseases and vasculitis; however, specific rheumatic diseases were not examined [7]. We also observed higher flare rates in female subjects in contrast to the Chinese study, in which subjects of older age had increased risk of flare [6].

The potential for mRNA and adenoviral vector vaccines to activate Toll-like receptors, intracellular sensors, and Type I interferon production theoretically exists, which could be hypothesized to impact disease activity for certain SRDs, such as lupus [17]. However, the observation that disease flare was uncommon and differed by diagnosis type suggests that genetic and other susceptibility factors may also be important. These should be verified in subsequent studies.

The association of flares with the Oxford-AstraZeneca vaccine, which is a replication-deficient simian adenovirus vector containing the full-length coding sequence of SARS-CoV-2 spike protein, as compared with the Pfizer-BioNTech mRNA vaccine warrants further evaluation. Of interest, the Oxford-AstraZeneca vaccine, female sex and age ≤55 years were associated with moderate or severe adverse events after COVID-19 vaccination in one prior study, though not specifically with disease flares [14]. Additionally, the Oxford-AstraZeneca vaccine has been associated with other autoimmune adverse events, including the risk of thrombotic events and autoimmune thrombocytopenia, and its association with SRD flares may be plausible [11]. The association between flares after COVID-19 vaccines in patients who reported a serious reaction to other non-COVID-19 vaccines in the past is also notable and suggests that an underlying immunophenotype may predispose patients to flares after COVID-19 and possibly other vaccines.

Prior studies in patients with SRD and systemic lupus erythematosus found a flare within 6 or 12 months prior to the COVID-19 vaccine to be associated with flares following vaccination [4, 5]. A recent study of SRD patient experiences with mRNA vaccines also reported the use of combination therapy to treat the underlying SRD and a prior history of SARS-CoV-2 infection to be associated with flares of SRD [5]. In the present study, we lacked information about disease activity at the time of vaccination, severity of disease flare, prior flare history, concomitant or additional immunomodulatory medications received including dosing and timing in relation to vaccination, as well as the number of patients who discontinued their medication before vaccination and after SRD flare. The background rate of flare was not quantified, and the survey did not collect information on whether flares occurred after first or second dose. This will be an important area of future research, particularly because patients who experience flares may be less willing to receive additional recommended doses.

Strengths of this study include the large size, the international perspective and the variety of SRDs exposed to different COVID-19 vaccines in the presence of varying co-morbid conditions. Furthermore, requiring a change in treatment to define flare reduced the potential misclassification of outcome such that flare was less likely to be conflated with common vaccine side effects, including fatigue, fever and joint pain. We were also able to estimate associations, taking into account multiple covariates in adjusted models, but we cannot rule out a role for unmeasured confounding factors.

TABLE 2 Multivariable-adjusted associations among COVID-19 vaccine-associated disease flares requiring change in treatment and potential predictors

	n/N	Multivariable OR (95% CI)
Age (per 5 years)	274/5619	0.97 (0.92, 1.02)
Sex		
Male	14/802	1.00 (ref)
Female	260/4817	**2.71 (1.55, 4.72)**
Race/ethnicity		
Non-Hispanic white	237/4602	1.00 (ref)
Non-white	37/1017	0.72 (0.49, 1.05)
Systemic rheumatic disease		
RA	77/1701	1.00 (ref)
Idiopathic inflammatory myopathies	16/824	**0.54 (0.31, 0.96)**
SLE	53/791	**1.51 (1.03, 2.20)**
Sjogren's syndrome	22/540	0.90 (0.55, 1.48)
PsA	24/304	**1.95 (1.20, 3.18)**
AS	17/291	1.55 (0.89, 2.71)
PMR	16/197	**1.94 (1.08, 2.48)**
Vasculitis	10/163	1.40 (0.70, 2.80)
Systemic sclerosis	2/135	0.34 (0.08, 1.42)
IBD	5/118	1.01 (0.40, 2.57)
GCA	3/67	1.01 (0.30, 3.36)
Psoriasis	4/67	1.29 (0.45, 3.69)
Asthma, chronic bronchitis, emphysema or COPD		
No	217/4689	1.00 (ref)
Yes	57/930	1.20 (0.88, 1.63)
BMI		
Non-obese (BMI $<30\,kg/m^2$)	208/4310	1.00 (ref)
Obese (BMI $\geq 30\,kg/m^2$)	66/1309	0.98 (0.73, 1.31)
Smoking status		
Never smoker	180/3456	1.00 (ref)
Past smoker	74/1792	0.84 (0.63, 1.12)
Current smoker	20/371	1.00 (0.62, 1.62)
COVID-19 vaccine		
Pfizer-BioNTech	137/3028	1.00 (ref)
Moderna	53/1035	1.29 (0.92, 1.81)
Oxford-AstraZeneca	76/1200	**1.44 (1.07, 1.95)**
Other	8/356	0.53 (0.25, 1.12)
Previous serious reaction to a non-COVID-19 vaccine		
No	230/5225	1.00 (ref)
Yes	44/394	**2.50 (1.76, 3.54)**
Withheld any SRD medication at time of vaccine		
No	183/3700	1.00 (ref)
Yes	79/1498	1.09 (0.83, 1.45)
No medications	12/421	0.72 (0.39, 1.33)

Odds ratios (OR) and 95% CI were calculated in logistic regression models adjusting for all covariates show in the table and full model results are shown. Bolded values are statistically signficant ($P < 0.05$). SRDs reported by >1% of participants shown. A full listing of systemic rheumatic diseases is in Supplementary Table S1, available at *Rheumatology* online. Estimates are mutually adjusted for all factors listed in the table. *n*: number of participants with both vaccination and disease flare; N: number of participants with vaccination.

Other important limitations to these findings include the use of self-reported data collected online in a volunteer sample, where diagnoses, disease flares and subsequent changes to treatment were not confirmed by a medical professional. To mitigate this possible misclassification, we required both self-report and a change in medication to increase the likelihood that this was a true flare. A previous study revealed that many mild flares are self-managed at home without involving medical professionals [18]. There may have been selection bias due to differential response to the questionnaire, with some unable to utilize the computer-based platform, as well as exclusion of patients too ill to respond or those who died due to COVID-19. We were unable to determine whether flares occurred after first or second dose in people receiving multiple doses in the initial

vaccine series, as the number of vaccine doses received was not queried.

Because some vaccine side effects may resemble flare of underlying SRD, we required report of medication change to enhance the specificity of the flare definition. However, some symptoms of flare may resemble vaccine side effects such as fatigue and arthralgia, though the later are typically transient. We lacked a comparator group to determine flare rates among patients who did not receive the vaccine over the same period. Given the baseline frequencies of disease flares for patients with SRD, it is likely that some of the reported disease flares were incidental and not causally related. Multiple factors could trigger SRD flare, including infection, psychosocial stress and poor medication adherence. The underlying risk of flare also differs among the autoimmune and inflammatory rheumatic diseases. The higher frequency of flares reported in patients with systemic lupus erythematosus, psoriatic arthritis and polymyalgia rheumatica may not be related to COVID-19 vaccination, but rather to a higher background flare rate for these SRDs.

While the GRA is a global initiative and the survey included many languages, most of the respondents who received the vaccine were in the region of the Americas and Europe with self-reported white race, likely due to availability of vaccine at the time the survey was conducted. Future studies will need to include more diverse populations. Taken together, these results should be interpreted cautiously, but call for future controlled, prospective studies to determine rates and predictors of disease flare after COVID-19 vaccination in patients with SRD.

In summary, our results found several factors associated with potential flares of SRD following COVID-19 vaccines. Population-based and prospective clinical studies are needed to confirm and extend these findings.

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Supplementary data

Supplementary data are available at *Rheumatology* online.

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