Received: 6 December 2021 | Accepted: 30 December 2021

Rheumatology & Autoimmunity

DOI: 10.1002/rai2.12028

ORIGINAL ARTICLE

The COVID-19 vaccine: Attitudes and vaccination in patients with autoimmune inflammatory rheumatic diseases

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Funding information

Beijing Natural Science Foundation, Grant/Award Number: 7192211

Abstract

Background: We examined attitudes toward the COVID-19 vaccine, potential factors underlying these attitudes, and ways to increase vaccination willingness in autoimmune inflammatory rheumatic diseases (AIIRD) patients.

Methods: A multicenter, web-based, observational survey using an online questionnaire was conducted among AIIRD patients aged ≥18 years from May 24, 2021, to June 3, 2021. Participants were 3104 AIIRD patients (2921 unvaccinated and 183 vaccinated).

Results: Of the unvaccinated patients, 32.9% were willing to receive the COVID-19 vaccine, 45.0% were uncertain, and 14.8% were unwilling. When vaccination was recommended by physicians, patients' willingness increased to 93.8%. Participants' main concerns were that the vaccine may aggravate AIIRD disease (63.0%) and may cause vaccine-related adverse events (19.9%). Female patients were less likely to be vaccinated. However, patients who had children aged ≤18 years were more willing to be vaccinated. In addition, vaccination willingness was higher in patients with trust in the safety and efficacy of the COVID-19 vaccine. Notably, 183 (5.9%) patients were vaccinated. The major vaccination side effects were injection reaction, myalgia, and fatigue. At a median follow-up of 88 (38, 131) days, patients' disease activities were stable.

Conclusions: The findings show that AIIRD patients were unwilling to receive the COVID-19 vaccine because of fears of potential disease exacerbation and additional adverse events. Sociodemographic characteristics and concerns about COVID-19 disease and vaccines had a significant effect on vaccination willingness.

KEYWORDS

autoimmune rheumatic diseases, COVID-19 vaccine, SARS-CoV-2, vaccine hesitancy

Key points

- The percentage of patients willing to receive the COVID-19 vaccine greatly increased when vaccination was recommended by a physician.
- Gender, marital status, age of the patients' children, smoking, trust in the safety and efficacy of the vaccine, and previous vaccinations had significant effects on the willingness of patients with AIIRDs to receive the COVID-19 vaccine.
- The data from vaccinated patients indicated no aggravation of AIIRD or additional adverse events.

Jiali Chen and Wenxin Cai contributed equally to this work.

1 | INTRODUCTION

The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2, COVID-19) pandemic has caused substantial morbidity and mortality worldwide, along with severe economic disruption. By the end of September 2021, COVID-19 had infected more than 234 million people and caused more than 4.7 million deaths worldwide (https://covid19.who.int/). Vaccination is the most important and effective way to prevent infectious diseases, including COVID-19.[1] The COVID-19 virus sequence was published on January 10, 2020. Since then, many countries, including China, America, Russia, and Germany, have worked in coordination with the World Health Organization to develop a vaccine. By January 2021, China had four vaccines that were being tested in large-scale clinical trials.[2]

Vaccine hesitancy is growing worldwide and was identified as one of the top 10 global threats by a 2019 World Health Organization report (https://www.who.int/news-room/spotlight/ten-threats-to-global-health-in 2019). The rapid development of the COVID-19 vaccines has led many individuals to be skeptical about their safety and efficacy. In addition, many social factors, including education, employment, income, and housing, are associated with distrust of COVID-19 vaccines. In a global survey of acceptance of the COVID-19 vaccine, 71.5% of participants said that they would be very or somewhat likely to receive a COVID-19 vaccine, and 61.4% stated that they would receive the vaccine if their employer advised them to.[3] The survey identified regional differences in vaccination willingness; for example, almost 90% of respondents in China, but less than 55% in Russia, reported that they were willing to receive the vaccine.[3] Therefore, to ensure COVID-19 herd immunity, much work remains to be done.

Patients with autoimmune inflammatory rheumatic diseases (AIIRDs) are immunocompromised and have a higher risk of experiencing worse outcomes from COVID-19.[4] Therefore, AIIRD patients should be prioritized for vaccination over the general population.[5] However, there is no direct evidence on the safety and efficacy of the COVID-19 vaccine in patients with AIIRDs, which may cause these patients to be unwilling or hesitant to be vaccinated.[6] Therefore, the study aim was to investigate attitudes toward the COVID-19 vaccine and identify the factors affecting vaccination in a Chinese cohort of AIIRD patients.

2 | METHODS

2.1 | Study design

This was a web-based, observational survey using an online questionnaire. The questionnaire was designed using the website http://www.wjx.cn/and consisted of 34 questions on sociodemographic characteristics, clinical profile, experience with COVID-19, willingness to receive the COVID-19 vaccine, and history of other vaccinations (Supporting Information Material). This online survey was conducted from May 24, 2021, to June 3, 2021, and disseminated using WeChat, the most popular social media site in China. Patients who received the inactivated COVID-19 vaccine[7,8] before the survey were followed-up using a combination of outpatient follow-up and telephone interview until July 8, 2021. Rheumatologists from 17 hospitals (15 tertiary centers and 2 secondary centers) distributed the survey link to their confirmed AIIRD patients who met the latest relevant classification standards in both inpatient and outpatient departments.

2.2 | Patients

The study focused on patients with AIIRDs who had been diagnosed in the participating hospitals using the latest classification of disease. Other inclusion criteria were that AIIRD patients had to be Chinese citizens, aged ≥18 years, and able to read and understand Chinese. Participants included patients with systemic lupus erythematosus (SLE), rheumatoid arthritis (RA), Sjögren's syndrome (SS), antiphospholipid syndrome, IgG4-related disease, systemic sclerosis, inflammatory myositis, Behçet's disease, antineutrophil cytoplasmic antibody associated vasculitis, Takayasu arteritis, ankylosing spondylitis, peripheral spondyloarthritis, psoriatic arthritis, reactive arthritis, enteropathic arthritis, undifferentiated connective tissue disease, mixed connective tissue disease, polymyalgia rheumatica, relapsing polychondritis, synovitis-acne-pustulosis-hyperostosis-osteomyelitis syndrome, and other rheumatic diseases.

2.3 | Study variables and outcomes of interest

Patients were divided into two groups: patients willing to be vaccinated (Yes) and patients unwilling to be vaccinated or those uncertain about vaccination (No or Uncertain). Patients who responded that they had not thought about vaccination or who had already been vaccinated were not included in this analysis. We assessed sociodemographic and clinical characteristics of AIIRD patients, experience with COVID-19 disease, and other vaccination history.

Variables related to sociodemographic characteristics, clinical profile (disease duration and comorbidities), experience with COVID-19 disease, willingness to receive COVID-19 vaccination, and other vaccination history were analyzed to examine their association with COVID-19 vaccination willingness. Participants were asked “Are you planning to get vaccinated against COVID-19 if the vaccine is generally available?” and “If vaccination was recommended by a physician, would you get vaccinated against COVID-19?” Possible responses were “Yes,” “No,” “Uncertain,” or “Have not thought about it.”

2.4 | Statistical analysis

Quantitative data were presented as the median and the 25th–75th percentile interquartile range. Qualitative

data were described as frequency (percentage). The Mann–Whitney *U* test and Fisher's exact test were used to compare the two groups. Univariate and multivariate logistic regression were used to analyze factors associated with COVID-19 vaccination willingness. Variables were then entered into multivariate logistic regression analyses using a stepwise approach. Results from the final regression are reported here. A two-sided p value <0.05 was considered statistically significant. Data were analyzed using the SPSS statistical software package (version 24.0, IBM Corp.).

3 | RESULTS

3.1 | Sociodemographic and clinical characteristics of patients with AIIRDs

During the study period, 3205 participants completed the questionnaire and 101 cases were excluded because of incomplete AIIRD information. A total of 3104 participants from 31 cities or provinces in China were included. Of these patients, 2921 patients were unvaccinated (2464 [84.4%] women; median age 41[33, 53] years) and 183 patients had been vaccinated. The unvaccinated patients were mainly distributed across four regions: Beijing (25.3%) and the provinces of Hebei (9.8%), Zhejiang (8.1%), and Guangdong (8.3%) (Figure 1).

The sociodemographic characteristics of AIIRD patients are summarized in Table 1. The clinical characteristics of AIIRD patients are summarized in Table 2. The most commonly reported AIIRDs were SLE (38.2%), RA (19.2%), and SS (17.0%). Approximately 29.6% of participants had at least one comorbidity, the most common of which was hypertension (10.7%), followed by chronic pulmonary disease (4.7%), diabetes mellitus (3.8%), and coronary heart disease (3.1%) (Table 2).

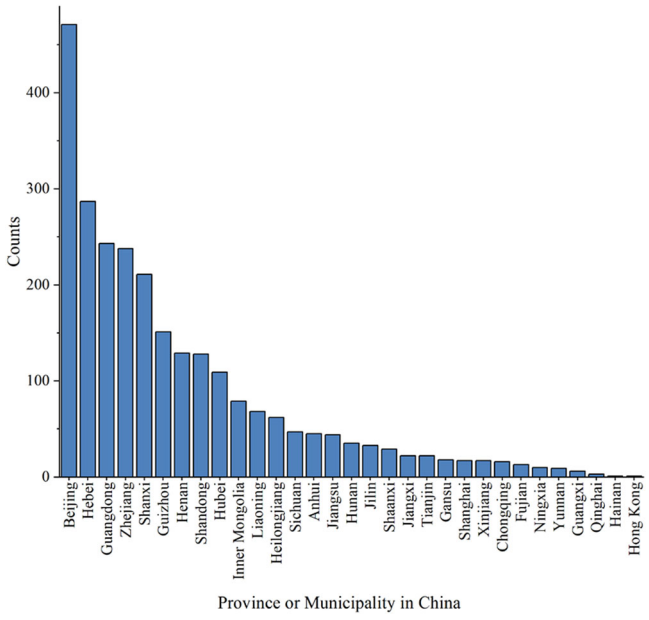

FIGURE 1 Distribution of AIIRD patients across China in this study. AIIRDs, autoimmune inflammatory rheumatic diseases

3.2 | Concerns about COVID-19 and willingness to receive the COVID-19 vaccine

When asked about their attitudes toward the COVID-19 vaccine, 61.1% of patients expressed confidence in the safety of the COVID-19 vaccine and 65.8% patients were confident about the efficacy of the COVID-19 vaccine. Regarding the effect of the vaccine on autoimmune disease, 26.1% of patients thought that the vaccine would aggravate such disease. Regarding the effect of autoimmune disease on the vaccine, 20.2% patients believed that having an AIIRD would increase the incidence of vaccine adverse events (Table 3). Regarding other vaccinations, 9.2% of patients had received the influenza vaccine in the last 5 years (Table 3).

The percentages of AIIRD patients who were willing, uncertain, and unwilling to receive the COVID-19 vaccine were 32.9%, 45.0%, and 14.8%, respectively. When vaccination was recommended by a physician, willingness increased to 93.8%. Notably, 54.7% of patients who were uncertain or unwilling voluntarily responded that they would get vaccinated if advised to by a physician, and 2.9% patients said they would not get vaccinated regardless of advice. For patients who were unwilling or uncertain, the main reasons were concerns about disease aggravation (63.0%), adverse events (19.9%), and the lack of long-term research (6.1%) (Table 4).

3.3 | Clinical characteristics of vaccinated AIIRD patients

Our cohort contained 183 patients who had been vaccinated against COVID-19. The most common AIIRD in these patients was SLE (39.9%), the median age of these patients was 39 (33, 48) years, and 71.5% of patients were women. The main side effects were injection reaction (18.5%), fatigue (15.3%), myalgia (13.1%), arthralgia or arthritis (5.4%), rash (3.8%), and headache (3.8%) (Table 5). At a median follow-up time of 88 (38, 131) days, the disease activities of these patients were stable.

3.4 | Factors associated with willingness to be vaccinated against COVID-19

Patients were divided into two groups according to vaccination willingness: the "Yes" group who were willing to be vaccinated (Yes, $n = 961$) and the "No or Uncertain" group (1745), who were uncertain about vaccination or were reluctant to be vaccinated. Patients who had not thought about vaccination were not included in this analysis.

Regarding sociodemographic characteristics, compared with the "No or Uncertain" group, the "Yes" group had more male patients (21.3% vs. 12.7%, $p < 0.001$) and more patients with children aged ≤18 years (41.2% vs. 33.1%, $p < 0.001$). In addition, more patients in the "Yes" group were current smokers (6.6% vs. 4.0%, $p = 0.003$) and past smokers (6.1% vs. 3.6%, $p = 0.002$) (Table 1).

TABLE 1 Sociodemographic characteristics of patients with AIIRDs

Demographic characteristics	Overall ($n = 2921$)	Yes ($n = 961$)	No or Uncertain ($n = 1745$)	p value[a]
Gender				
Female	2464 (84.4)	756 (78.7)	1524 (87.3)	<0.001
Age, years	41 (33, 53)	40 (33, 53)	41 (33, 54)	0.511
BMI, kg/m^2	22.6 (20.4, 25.1)	22.7 (20.7, 25.4)	22.4 (20.3, 25.0)	0.048
Marital status				
Unmarried	465 (15.9)	146 (15.2)	288 (16.5)	0.310
Married	2209 (75.6)	749 (77.9)	1293 (74.1)	0.072
Divorced	132 (4.5)	36 (3.7)	87 (4.9)	0.123
Widowed	39 (1.3)	12(1.2)	25 (1.4)	0.669
No answer	76 (2.6)	18 (1.9)	52 (2.9)	0.083
Have children less than 18-year-old	1050 (35.9)	392 (41.2)	572 (33.1)	<0.001
Education level				
Less than high school	478 (16.4)	159(16.5)	248 (14.2)	0.101
High school or equal education	1329 (45.5)	442 (45.9)	791 (45.3)	0.716
Bachelor's degree	935(32.0)	297 (30.9)	596 (34.2)	0.089
Postgraduate degree	156 (5.3)	54 (5.6)	96 (5.5)	0.892
No answer	23 (0.8)	9 (0.9)	14 (0.8)	0.716
Income level per year, CNY				
≤30,000	693 (23.7)	224 (23.3)	383 (21.9)	0.453
30,000-80,000	1070 (36.6)	357 (37.1)	644 (36.9)	0.975
80,000-300,000	830 (28.4)	272 (28.3)	523 (30.0)	0.318
≥300,000	205 (7.0)	74 (7.7)	125 (7.2)	0.633
No answer	123 (4.2)	34 (3.5)	70 (4.0)	0.540
Smoking				
Current smoking	143 (4.9)	63 (6.6)	70 (4.0)	0.003
Past smoking	130 (4.5)	59 (6.1)	62 (3.6)	0.002
Nonsmoking	2633 (90.1)	835 (86.9)	1604 (91.9)	<0.001
Drinking	187 (6.4)	75	102	0.046

Note: Data are median (interquartile range) or *n* (%).

Abbreviations: AIIRDs, autoimmune inflammatory rheumatic diseases; BMI, body mass index.

[a]*p*-values were calculated using Mann–Whitney *U* test or Fisher's exact test as appropriate.

Regarding clinical characteristics, compared with the "No or Uncertain" group, the "Yes" group had fewer patients with SLE (35.7% vs. 39.5%, $p = 0.043$) (Table 2).

Regarding concerns about the health effects of COVID-19 disease, patients in the "Yes" group were more worried about the effects of COVID-19 than those in the "No or Uncertain" group (40.3% vs. 31.0%, $p < 0.001$). Compared with patients in the "No or Uncertain" group, patients in the "Yes" group were more confident about the safety (76.7% vs. 53.2%, $p < 0.001$) and the efficacy (79.7% vs. 59.2%, $p < 0.001$) of the COVID-19 vaccine. In accord with this, patients in the "No or Uncertain" group were more worried that the vaccine would aggravate their protopathy (32.5% vs. 18.1%, $p < 0.001$) and worried about the higher risk of adverse events after vaccination (25.7% vs. 13.7%, $p < 0.001$) (Table 3).

In terms of other type of vaccinations, more patients in the "Yes" group had received influenza vaccines (11.6% vs. 8.4%, $p = 0.008$) than those in the "No or Uncertain" group (Table 3).

Multivariable logistic regression analysis of attitudes toward COVID-19 vaccination suggested that women (odds ratio [OR]: 0.56, 95% confidence interval [CI]: [0.42, 0.74], $p < 0.001$) were less motivated to be vaccinated than men. Participants who had children aged ≤18 years of age (OR: 1.47, 95% CI: [0.21, 1.78], $p < 0.001$) were more willing to be vaccinated than patients with children aged >18 years (Figure 2A).

TABLE 2 Clinical characteristics of patient with AIIRDs

Variables	Overall ($n = 2921$)	Yes ($n = 961$)	No or Uncertain ($n = 1745$)	p value[a]
Autoimmune inflammatory rheumatic diseases				
Systemic lupus erythematosus	1116 (38.2)	343 (35.7)	690 (39.5)	0.043
Rheumatoid arthritis	560 (19.2)	186 (19.4)	310 (17.8)	0.306
Sjögren's Syndrome	496 (17.0)	160 (16.6)	312 (17.9)	0.460
Disease duration, years				
1-10	2043 (69.9)	682 (71.0)	1215 (69.6)	0.480
11-20	648 (22.2)	210 (21.9)	388 (22.2)	0.807
21-30	132 (4.5)	39 (4.1)	78 (4.5)	0.610
≥31	34 (1.2)	9 (0.9)	24 (1.4)	0.318
No answer	64 (2.2)	21 (2.2)	40 (65.6)	0.858
Comorbidities	865 (29.6)	271 (28.2)	526 (30.1)	0.536
Hypertension	313 (10.7)	103 (10.7)	186 (10.7)	0.43
Chronic pulmonary disease	137 (4.7)	48 (5.0)	80 (4.6)	0.377
Diabetes mellitus	112 (3.8)	38 (4.0)	67 (3.8)	0.499
Coronary heart disease	91 (3.1)	32 (3.3)	52 (3.0)	0.402
Cerebrovascular disease	56 (1.9)	13 (1.4)	38 (2.2)	0.239
Cancer	61 (2.1)	15 (1.6)	42 (2.4)	0.257

Note: Data are *n* (%).

Abbreviation: AIIRDs, autoimmune inflammatory rheumatic diseases.

[a]*p* values were calculated using Fisher's exact test.

Notably, willingness to be vaccinated increased with trust in the safety and efficacy of the COVID-19 vaccine ($p < 0.001$). Importantly, vaccination willingness was higher among participants who had received the influenza vaccine compared with that among those who had not (OR: 1.34, 95% CI: [0.99, 1.80], $p = 0.057$), but the difference was insignificant (Figure 2B).

4 | DISCUSSION

Vaccination is generally recommended for AIIRD patients aged ≥16 years old by the American College of Rheumatology clinical guidance.[9] In the present study, 32.9% of AIIRD patients responded that they would be willing to receive the vaccine if it were safe and effective, and 93.8% said that they would be willing to be vaccinated if advised to do so by a physician. A previous international survey conducted across 19 countries[3] found that vaccination willingness in the general population in China was 88.6%, which is substantially higher than vaccination willingness in AIIRD patients in the present study. A major reason for the difference in vaccination willingness between AIIRD patients and the general population may be that AIIRD patients are concerned that the vaccine may aggravate their protopathy and cause vaccine-related adverse events. In addition, our findings differed from reports on vaccination willingness in an international study[6] of COVID-19 vaccinations (VAXICOV) conducted among 1531 patients with autoimmune and rheumatic diseases. This previous study found that the percentage of patients willing to be vaccinated against COVID-19 was 54.2%, which increased to 62.8% when vaccination was recommended by a physician. Notably, we found that 1778 (60.9%, increased from 32.9% to 93.8%) uncertain or reluctant patients responded that they would get vaccinated after being advised to by a physician, which suggests that vaccine willingness could be increased by positive encouragement from rheumatologists. It is possible that some AIIRD patients believed that it is no longer necessary for AIIRD patients in China to be vaccinated because COVID-19 is now well-controlled in China. However, given the severity of the global pandemic situation, we believe that COVID-19 remains a potential risk to public health.

Our findings showed that gender, and age of the patients' children, had significant effects on vaccination willingness. In line with the VAXICOV study, women in this study were less likely than men to accept vaccination.[6] The present findings showed that women were more worried about the adverse events of the COVID-19 vaccine than men (84.4% vs. 15.2%). However, the only currently known adverse reactions to COVID-19 vaccines are injection site reactions, constitutional symptoms, and allergic reactions to the vaccine ingredients.[8] Patients with rheumatic diseases are known to be at higher risk of severe COVID-19 infection because of abnormalities in the host immune system.[10] Therefore, there is no evidence that the side effects of the COVID-19 vaccine outweigh the benefits for AIIRD patients. In line with the available guidance, vaccination is recommended for

TABLE 3 Concerns about COVID-19 and vaccination in patients with AIIRDs

Variables	Overall ($n = 2921$)	Yes ($n = 961$)	No or Uncertain ($n = 1745$)	p value[a]
Concerns about health impact of COVID-19				
No	447 (15.3)	117 (12.2)	251 (14.4)	0.109
Slightly	1502 (51.4)	456 (47.5)	951 (54.6)	<0.001
Very	963 (33.0)	386 (40.3)	540 (31.0)	<0.001
COVID-19 sickness in myself or family members	8 (0.3)	1 (0.1)	5 (0.3)	0.369
Living in the area of high or median risk of COVID-19	163 (5.6)	55 (5.7)	98 (5.6)	0.911
Safety of the COVID-19 vaccine				
Disagree	108 (3.7)	16 (1.7)	83 (4.8)	<0.001
Neutral/no opinion	1027 (35.2)	208 (21.6)	733 (42.0)	<0.001
Agree	1786 (61.1)	737 (76.7)	929 (53.2)	<0.001
Efficacy of the COVID-19 vaccine				
Disagree	76 (2.6)	13 (1.4)	54 (3.1)	0.005
Neutral/No opinion	924 (31.6)	182 (18.9)	658 (37.7)	<0.001
Agree	1921 (65.8)	766 (79.7)	1033 (59.2)	<0.001
Impact of the vaccine on autoimmune disease				
Will aggravate disease activity	763 (26.1)	174 (18.1)	567 (32.5)	<0.001
Will not influence disease activity	107 (3.7)	63 (6.6)	41 (2.3)	<0.001
Will improve disease activity	32 (1.1)	23 (2.4)	8 (0.5)	<0.001
No opinion	1998 (68.4)	693 (72.1)	1116 (64.0)	<0.001
Impact of autoimmune disease on the vaccine				
Will be more effective	70 (2.4)	60 (6.2)	9 (0.5)	<0.001
Will be less effective	196 (6.7)	75 (7.8)	116 (6.6)	0.27
Adverse events will be higher	591 (20.2)	132 (13.7)	448 (25.7)	<0.001
Adverse events will be smaller	13 (0.4)	2 (0.2)	8 (0.5)	0.484
Other	119 (4.1)	38 (4.0)	73 (4.2)	0.762
No opinion	1921 (65.8)	652 (67.8)	1082 (62.0)	0.003
Have got influenza vaccine in the last 5 years	268 (9.2)	111 (11.6)	147 (8.4)	0.008
Have got pneumococcal vaccine in the last 5 years	64 (2.2)	27 (2.8)	36 (2.1)	0.215
Have got herpes zoster vaccine in the last 5 years	3 (0.1)	3 (0.3)	0 (0.0)	0.083
Have got human papillomavirus vaccine in the last 5 years	89 (3.0)	37 (3.9)	50 (2.9)	0.165
Have got hepatitis B virus vaccine in the last 5 years	88 (3.0)	33 (3.4)	49 (2.8)	0.359

Note: Data are *n* (%).

Abbreviation: AIIRDs, autoimmune inflammatory rheumatic diseases.

[a]*p* values were calculated using Fisher's exact test.

patients with well-controlled AIIRD, but not for patients with life-threatening illness.

Another important finding was that trust in vaccine safety and efficacy is important in persuading patients to receive the COVID-19 vaccine. Our findings show that vaccination willingness was higher in patients with trust in the safety and efficacy of the COVID-19 vaccine, which is similar to previous findings.[3,6] The rapid pace of vaccine development has further increased public hesitancy. In our study, 59.7% of patients were uncertain about or unwilling to be vaccinated. These findings are consistent with a previous report that approximately 30% of Americans were unsure about whether to be vaccinated, and 20% said they would not get vaccinated.[2] Therefore, vaccine hesitancy remains a common challenge to those working toward increasing vaccination rates. Clear and consistent communication by physicians and government officials is essential to build public confidence in vaccine programs. In addition, we observed that patients who had received an influenza vaccine were more willing to receive the COVID-19 vaccine. Previous studies have shown that the influenza vaccine is safe and effective for stable SLE

TABLE 4 Willingness of patients with AIIRDs to get the COVID-19 vaccine

Variables	Overall ($n = 2921$)
Accept COVID-19 vaccine if generally available, *n* (%)	
Yes	961 (32.9)
No	432 (14.8)
In doubt	1313 (45.0)
Did not think about it	209 (7.2)
Most important reason for vaccination ($n = 961$), *n* (%)	
Care about personal health	550 (57.2)
Care about others' health	31 (3.2)
To contribute to herd immunity	340 (35.4)
Other	33 (3.4)
Reasons for unwilling or doubting vaccination ($n = 1745$), *n* (%)	
Aggravating the autoimmune disease	1099 (63.0)
Worrying about adverse events	347 (19.9)
Lacking long-term research	106 (6.1)
Unnecessary	58 (3.3)
Worrying about effectiveness	15 (0.9)
Inducing a COVID-19 infection	14 (0.8)
Injection reaction	2 (0.1)
Others	88 (5.0)
Accept COVID-19 vaccine if physician recommended it, *n* (%)	
Yes	2739 (93.8)
No	166 (5.7)
Influence of physician on decision to vaccinate, *n* (%)	
Positive influence	
Doubt about vaccination, but will vaccinate after getting advice	1253 (42.9)
Will vaccinate only after getting advice	345 (11.8)
No influence	
Will vaccinate regardless of advice	950 (32.5)
Will not vaccinate regardless of advice	85 (2.9)
Doubt about vaccination, but will not vaccinate after getting advice	53 (1.8)

Note: Data are *n* (%).

Abbreviation: AIIRDs, autoimmune inflammatory rheumatic diseases.

TABLE 5 Clinical characteristics and adverse events experienced by patients who were vaccinated

Variables	Overall ($n = 183$)
Autoimmune inflammatory rheumatic diseases, *n* (%)	
Ankylosing spondylitis	38 (20.8)
Systemic lupus erythematosus	73 (39.9)
Sjögren's Syndrome	14 (7.7)
Rheumatoid arthritis	26 (13.7)
Behçet's Disease	3 (1.6)
Antiphospholipid syndrome	8 (4.4)
Psoriatic arthritis	3 (1.6)
Others	12 (6.6)
Gender, Male/Female, *n* (%)	52 (28.4)/131 (71.5)
Age, years, median (IQR)	39 (33, 48)
Adverse events, *n* (%)	
Injection reaction	34 (18.5)
Myalgia	24 (13.1)
Fatigue	28 (15.3)
Headache	7 (3.8)
Arthralgia	10 (5.4)
Rash	7 (3.8)
Fever	6 (3.2)
Nausea	4 (2.1)
Chill	1 (0.5)
Others	20 (10.9)

Note: Data are median (interquartile range) or *n* (%).

patients receiving standard treatment.[11] In addition, patients with primary SS develop higher levels of vaccine-specific immunoglobulin compared with healthy controls, and their disease activity and associated parameters remain stable.[12] Moreover, patients with RA are stable and require less consultation for joint pain after vaccination.[11] In this study, we reported the follow-up responses from patients who had received COVID-19 vaccination. The main adverse events experienced by these patients were similar to those reported by the general population.[8,13,14] In addition, these patients were followed-up after approximately 3 months and did not report any significant exacerbation of disease activity. These results suggest that the benefits of the vaccine outweigh the risks for stable AIIRD patients; therefore, rheumatologists should actively encourage these patients to receive the COVID-19 vaccine.

This study had some limitations. First, although the completion of the study within several few weeks confirms the feasibility of using social media for sampling large cohorts of patients with AIIRD diseases, vaccine decisions are based on multiple factors and can change over time; a patient's willingness to be vaccinated at the time of the survey may not necessarily predict eventual acceptance. Second, although more than 3205 patients nationwide participated in the survey, participation bias may have occurred. Third, we examined only the clinical symptoms of vaccinated patients and did not investigate laboratory parameters and other immunological changes, which may increase understanding of immune responses after vaccination in AIIRD patients and the long-term effects on disease severity. Therefore, additional research

(A)

Variables	OR (95% CI)	P value
Gender, Male (Reference)		
Female	0.56 (0.42, 0.74)	<0.001
Age, years, 18-30 (Reference)		
31-59	1.04 (0.70, 1.54)	0.853
≥60	1.10 (0.83, 1.46)	0.508
Education, Less than high school (Reference)		
High school or some college	0.86 (0.54, 1.35)	0.503
Bachelor's degree	0.99 (0.66, 1.48)	0.967
Postgraduate degree	1.12 (0.76, 1.66)	0.566
Income, RMB, ≤30,000 (Reference)		
30,000-80,000	1.10 (0.75, 1.62)	0.623
80,000-300,000	1.06 (0.74, 1.50)	0.758
≥300,000	1.14 (0.81, 1.60)	0.47
Marital status, Unmarried (Reference)		
Married	0.88 (0.38, 2.01)	0.758
Divorced	0.90 (0.41, 1.94)	0.777
Widowed	1.04 (0.43, 2.48)	0.938
Children ≤ 18-year-old, No (Reference)		
Yes	1.47 (0.21, 1.78)	<0.001
Smoking, Non-smoking (Reference)		
Current smoking	1.53 (0.97, 2.40)	0.067
Past smoking	1.20 (0.69, 2.07)	0.522
Disease duration, years, 1-10 (Reference)		
11-20	0.42 (0.15, 1.13)	0.085
21-30	0.39 (0.14, 1.07)	0.068
≥31	0.45 (0.15, 1.31)	0.14
Comorbidities, No (Reference)		
Yes	0.92 (0.76, 1.12)	0.394

(B)

Variables	OR (95% CI)	P value
COVID-19 sickness, No (Reference)		
Yes	0.29 (0.03, 2.53)	0.263
Area with risk of COVID-19, No (Reference)		
Yes	1.08 (0.76, 1.54)	0.669
Vaccine is safe, Disagree (Reference)		
Neutral/ no opinion	3.88 (1.76, 8.56)	0.001
Agree	2.13 (1.61, 2.83)	<0.001
Vaccine is effective, Disagree (Reference)		
Neutral/ no opinion	0.99 (0.40, 2.41)	0.973
Agree	1.45 (1.08, 1.95)	0.014
Influenza vaccine, No (Reference)		
Yes	1.34 (0.99, 1.80)	0.057
Pneumococcal vaccine, No (Reference)		
Yes	1.01 (0.56, 1.81)	0.987
Human papillomavirus vaccine, No (Reference)		
Yes	1.23 (0.78, 1.94)	0.383
Hepatitis B virus vaccine, No (Reference)		
Yes	1.14 (0.72, 1.82)	0.578

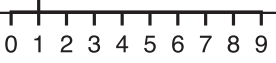

FIGURE 2 Multivariate logistic regression analysis of acceptance of the COVID-19 vaccination. Variables related to demography (A), and concerns about COVID-19 (B). Patients who had not thought about vaccination were not included in this analysis. Patients were divided into two groups according to vaccination willingness: patients willing to be vaccinated and patients uncertain about vaccination or unwilling to be vaccinated. Data are presented as odds ratios (ORs) with the corresponding 95% confidence interval (CI)

on the postvaccination pathogenesis of patients with AIIRDs is required.

5 | CONCLUSIONS

In conclusion, AIIRD patients had a lower incidence of voluntary vaccination. However, their hesitancy could be resolved by the positive recommendations of rheumatologists. Sociodemographic and clinical characteristics of AIIRD patients and concerns about COVID-19 disease may affect vaccination willingness. This information could help governments and policymakers to take reasonable measures to increase vaccine coverage in AIIRD populations to meet the requirements for community immunity.

ACKNOWLEDGMENTS

We are very grateful to the rheumatologists from the following participating hospitals: the Second Affiliated Hospital of Zhejiang University School of Medicine, Peking University International Hospital, Xuanwu Hospital of Capital Medical University, Shanxi Bethune Hospital, Beijing Hospital of Traditional Chinese Medicine, Hebei Yiling Hospital, the First People's Hospital of Yangquan, Tongliao City Hospital, Ordos Central Hospital, Aerospace Center Hospital, the Second Affiliated Hospital of Guizhou University of Traditional Chinese Medicine, Beijing Shijingshan Hospital, Xinxiang City Central Hospital, Cangzhou Central Hospital, Peking University Shenzhen Hospital, and Qinhuangdao Port Hospital. We also thank the patients and their families for their cooperation and for consenting to participate in this study. This study was funded by Beijing Natural Science Foundation (Grant No. 7192211). The funder of the study had no role in the study design, data collection, data analysis, data interpretation, or writing of the report. The corresponding author had full access to all the study data and had the final responsibility for the decision to submit the manuscript for publication.

CONFLICT OF INTERESTS

The authors declare that there are no conflict of interests.

ETHICS STATEMENT

The study was approved by the ethics committee of Peking University People's Hospital (2018PHB115). The patients were informed that completion of the questionnaire implied consent, and that participation was anonymous and voluntary.

AUTHOR CONTRIBUTIONS

Jiali Chen and Wenxin Cai analyzed the results and wrote the manuscript. These two authors contributed equally to this work and should be considered co-first authors. Tian Liu, Yunshan Zhou, Yuebo Jin, Yue Yang, and Shi Chen conducted and supervised the survey. Chun Li designed, supervised, and edited the manuscript. Kun Tang designed the questionnaire.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author, Chun Li, upon reasonable request. Supporting Information material associated with this article can be found in the online version of the article.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

How to cite this article: Chen J, Cai W, Liu T, et al. The COVID-19 vaccine: attitudes and vaccination in patients with autoimmune inflammatory rheumatic diseases. *Rheumatol & Autoimmun*. 2022;2:82-91. doi:10.1002/rai2.12028

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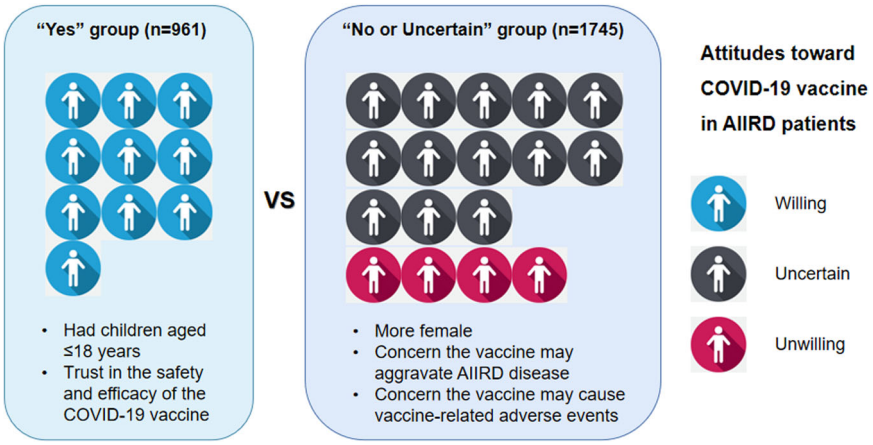

The population characteristics of AIIRD patients with different attitudes towards COVID-19 vaccine.