ORIGINAL RESEARCH

Questionnaire Survey on Vaccination Willingness and the Status of COVID-19 Vaccination Among Patients with Rheumatic Disease: A Single-Center Survey in China

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Introduction: The COVID-19 pandemic is an ongoing global pandemic. Patients with rheumatic disease are more likely to be infected with COVID-19 than the general population, and they should be vaccinated against COVID-19 for protection. This study aimed to understand the willingness to receive the COVID-19 vaccine among these patients.

Methodology: Patients who came to the Rheumatology and Immunology Department of our hospital from July 3–20, 2021, were randomly selected for a self-designed survey via an online questionnaire platform. Four hundred seventeen questionnaires were validated.

Results: Males were more likely to underestimate the risk of COVID-19 infection than females, and medical workers had a higher perception of COVID-19 infection risk than nonmedical workers (both $P < 0.05$). Among the included patients, 149 (35.73%) patients were hesitant to be vaccinated, while 268 (64.27%) patients are willing to accept vaccination. Logistic regression analysis showed that men were more willing to be vaccinated than women, and nonmedical workers were more willing to be vaccinated than medical workers (both $P < 0.05$). A total of 55.40% of the patients did not receive the COVID-19 vaccine. The incidence of adverse reactions for the 167 patients who received the COVID-19 vaccine was 8.98%.

Conclusion: The vaccination rate of the patients with rheumatic disease was relatively low, as was their vaccination willingness. Patient sex, whether the patient was a medical worker, and the patient's level of knowledge about the risk of COVID-19 infection and the impact of vaccination on the disease were key factors.

Keywords: COVID-19 vaccine, COVID-19, rheumatic disease, vaccination willingness

Introduction

The coronavirus disease 2019 (COVID-19) pandemic is a global pandemic. As of December 23, 2021, the World Health Organization (WHO) data platform showed a total of 275,233,892 confirmed cases of COVID-19 and 5,364,996 deaths worldwide.[1] The Delta variant and "highly mutated" Omicron variant have made the COVID-19 pandemic even worse.[2,3] Because the population at large is generally susceptible to COVID-19, vaccination against COVID-19 is an effective means of preventing transmission.[4] Patients with rheumatic disease are more likely to be infected with COVID-19 than the general population.[5] Another study by Ungaro et al suggested that the systemic use of corticosteroids may add to the risk of severe COVID-19 for patients with autoimmune and chronic inflammatory diseases.[6] A number of guidelines at home and abroad recommend that eligible patients with rheumatic disease receive the COVID-19 vaccine when their condition is stable.[7,8] At present, however, the general population generally does not have strong vaccination intentions and hesitates to get vaccinated, which leads to delays in vaccination and prevention.[9–11] In this study, we investigated the perceptions of COVID-19 infection in patients with rheumatic disease in our hospital through an online questionnaire on

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the Wenjuanxing platform (web link: www.wjx.cn), analyzed the factors influencing their willingness to receive a COVID-19 vaccine, and analyzed the characteristics of patients who had been vaccinated in an attempt to better counsel patients with rheumatic disease regarding vaccination.

Materials and Methods
Participants
Data from patients with rheumatic disease who presented to the Rheumatology and Immunology Department Outpatient Clinic at our hospital from July 3–20, 2021, were collected in the database. After cluster sampling by disease, these patients' data were randomly sequenced using a random number table, and then patients were randomly selected. They completed the questionnaire under the instruction of a blinded medical worker. Four hundred sixty-three questionnaires were distributed, and 463 were effectively returned (recovery rate = 100%).

The inclusion criteria for patients with rheumatic immune disease were as follows: 1. Patients with rheumatoid arthritis who met the classification criteria for rheumatoid arthritis formulated by the American College of Rheumatology (ACR)/European League Against Rheumatism (EULAR) in 2010; 2. Patients with systemic lupus erythematosus (SLE) who met the SLE classification criteria established by the EULAR/ACR in 2019; 3. Patients with Sjögren's syndrome who met the 2016 ACR/EULAR classification criteria for Sjögren's syndrome; 4. Patients with polymyositis/dermatomyositis who met the dermatomyositis diagnostic criteria developed by Bohan and Pete in 1975; 5. Patients with gout conforming to the gout classification criteria formulated by the ACR/EULAR in 2015; 6. Patients with osteoarthritis who met the diagnostic criteria for osteoarthritis revised by the ACR in 1995;

7. Patients with ankylosing spondylitis who met the classification criteria for axial spondylarthritis (SpA) recommended by the ASAS (International Spondylarthritis Expert Collaboration Group) in 2009; 8. Patients with psoriatic arthritis who met the 2006 CASPAR classification diagnostic criteria; 9. Patients who underwent enteroscopy and were diagnosed with inflammatory bowel disease-associated arthritis that is consistent with the diagnosis of ulcerative colitis and Crohn's disease with peripheral arthritis and axial joint disease, in which the diagnosis could be made by excluding other joint diseases; 10. Patients with systemic sclerosis who met the 2013 ACR/EULAR classification criteria for systemic sclerosis;

11. Patients with Takayasu arteritis who met the 1990 ACR diagnostic criteria for Takayasu arteritis; 12. Patients with Antineutrophil cytoplasmic antibody-associated vasculitis who met the provisional classification criteria of antineutrophil cytoplasmic antibody (ANCA)-associated vasculitis included in the 2017 EULAR-ACR criteria; 13. Adult patients with Still's disease who met the 1992 Japanese Yamaguch criteria; 14. Patients with polymyalgia rheumatica who met the 2005 ACR/EULAR PMR classification criteria for polymyalgia rheumatica; 15. Patients with IgG4-related diseases who met the 2019 ACR/EULAR IgG4-related disease classification criteria; 16. Patients with mixed connective tissue disease who met the 1983 Kahn diagnostic criteria; 17. Patients with undifferentiated connective tissue disease with one or more typical symptoms or signs of rheumatism, one or more high-titer autoantibodies, and for whom the course of disease was > 2 years, excluding patients with any other connective tissue disease; and 18. Patients with antiphospholipid antibody syndrome who met the 2006 revised classification criteria for Sapporo antiphospholipid syndrome. Patients were evaluated for disease remission or acute exacerbation according to their symptoms, signs and auxiliary examinations according to the disease's evaluation criteria; for example, patients received a DAS28 score for rheumatoid arthritis (a DAS score <2.6 indicates remission), an SLE-DAI score for SLE (an SLEDAI score ≤4 indicates inactivity), and an ASDAS score for ankylosing spondylitis (an ASDAS score < 1.3 indicates inactivity). The exclusion criteria included patients aged <18 years old, patients who were illiterate, patients with a loss of comprehension and expression ability, and critically ill patients.

Each patient could only complete the questionnaire once. Verification of validity was established through a questionnaire setting the quality control conditions as follows: 1) Only when the response to Question 8 of the Questionnaire (Are you a patient with rheumatic immune disease? [single-choice question, if you choose yes, please continue to answer; if you choose no, the questionnaire is invalid]) was affirmative was the questionnaire considered valid; 2) A total answering time <10 s or > 2 min invalidated the questionnaire; and 3) Each question must be completed before the next question was presented. Incomplete answer sheets were not collected. The information of all questionnaires was checked by the Wenjuanxing online system and double-checked by the investigator. Forty-six (9.9%) invalid questionnaires were excluded; thus, 417 were valid.

Study Approach

The participants scanned the QR code of Wenjuanxing on WeChat and completed the self-designed online questionnaire titled "A Survey on the Willingness of Patients with Rheumatic Disease to Receive a COVID-19 Vaccine". There were 25 questions in the questionnaire, covering the basic information of the respondents and assessing their rheumatic disease status, their perceptions of COVID-19 infection risk and its impact on rheumatic disease, their perception levels and willingness to receive a COVID-19 vaccine, and their COVID-19 vaccination status. The Cronbach's alpha coefficient of the questionnaire reliability test was 0.715, which was acceptable The Kaiser–Meyer–Olkin (KMO) test of validity was 0.5, and the cumulative variance interpretation rate was 62.41%.

Statistical Analysis

The survey data from the questionnaires were exported and analyzed using SPSS (version 22.0) statistical software. Univariate analysis was performed by a χ^2 test, and multivariate analysis was performed by logistic regression (α=0.05, two-sided test). Analysis of variance (ANOVA) was used to analyze the impact of six variables, including the sex, age, marital status, educational level, place of residence, and occupation (medical or nonmedical) of the respondent, the respondent's family members, relatives, and friends' perceptions of COVID-19 infection risk, as well as the impact of the patient's perception of COVID-19 infection on rheumatic disease. Twelve factors, including the sex, age, marital status, educational level, place of residence, and occupation (medical or nonmedical) of the respondent, the respondent's family members, relatives and friends' perceptions of COVID-19 infection risk, disease assessment, risk perception of COVID-19 infection, perception of the impact of COVID-19 infection on rheumatic disease, perception of the impact of COVID-19 vaccination on rheumatic disease, and vaccination with other vaccines in the last 5 years (other than the COVID-19 vaccine), were analyzed as independent variables and the willingness to receive COVID-19 vaccination was analyzed as a dependent variable in logistic linear regression analysis.

Ethics Statement

Since this was a survey study, the study was granted an exemption from the requirement of written informed consent by the institutional ethics committee of Heping Hospital Affiliated to Changzhi Medical College. Oral consent was obtained from the participants (or their parent/legal guardian/next of kin) for participation in the study. This study was conducted ethically in accordance with the World Medical Association Declaration of Helsinki and complied with the guidelines for human studies.

Results

Demographic Characteristics

The demographic characteristics of the respondents are presented in Table 1. Among the participants, the majority were female (292 [70.02%]). The age distribution was as follows: 39 respondents were aged 18–29 years (9.35%); 77 were aged 30–39 years (18.47%); 123 were aged 40–49 years (29.50%); 122 were aged 50–59 years (29.26%); 39 were aged 60–65 years (9.35%); and 17 were aged > 65 years (4.08%). Most of the respondents were married (376 [90.17%]). The respondents' places of residence were as follows: 184 lived in cities (44.12%); 96 lived in counties (23.02%); 32 lived in towns (7.67%); 104 lived in villages (24.94%); and 1 had no permanent residence (0.24%). The occupations of the participants were as follows: 19 were medical workers (4.56%); and 398 were nonmedical workers (95.44%). The occupations of the respondents' family members, relatives, and friends were as follows: 124 were medical workers (29.74%); and 293 were nonmedical workers (70.26%).

Evaluation of Rheumatic Disease

Among the participants, 350 (83.93%) were in the remission stage of rheumatic disease, while 67 (16.07%) were in the active stage. Four hundred seventeen participants had 448 episodes of rheumatic disease. The composition of rheumatic disease among the participants was as follows (the respondents were permitted to choose more than one option): 171 had rheumatoid arthritis (38.17%); 74 had SLE (16.52%); 65 had ankylosing spondylitis (14.51%); 31 had gout (6.92%); 26 had Sjogren's syndrome (5.8%); 18 had osteoarthritis (4.02%); 14 had connective tissue disease (3. 13%); 7 had systemic sclerosis (1.56%); 5 had Takayasu arthritis (1.12%); 4 had polymyalgia rheumatica (0.90%); 3 had psoriatic arthritis

Table 1 Demographic Details of the Study Participants

Variables	Total Participants (Number=417)	Percentage
Sex		
Male	125	29.98
Female	292	70.02
Age (years)		
18–29	39	9.35
30–39	77	18.47
40–49	123	29.50
50–59	122	29.26
60–65	39	9.35
65 and older	17	4.08
Marital status		
Married	376	90.17
Unmarried	33	7.91
Divorced or widowed	8	1.92
Place of residence		
Cities	184	44.12
Counties	96	23.02
Towns	32	7.67
Villages	104	24.94
No fixed place of residence	1	0.24
Occupation		
Medical	19	4.56
Nonmedical	398	95.44
Occupations of family members, relatives, and friends		
Medical	124	29.74
Nonmedical	293	70.26

(0.67%); 3 had ANCA-related vasculitis (0.67%); 3 had antiphospholipid antibody syndrome (0.67%); 2 had polymyositis (0.45%); 2 had dermatomyositis (0.45%); 2 had undifferentiated spondyloarthropathy, 2 (0.45%); 2 had adult-onset Still's disease (0.45%); and 16 had other rheumatic diseases (3.57%).

Perceptions of Patients with Rheumatic Disease Regarding COVID-19 Infection

Among the participants, 127 (30.46%) believed they had no risk of COVID-19 infection, while 199 (47.72%) were uncertain about their risk. The results of ANOVA showed that the sexes had different risk perceptions of COVID-19 infection (p<0.05), while age, marital status, place of residence, respondent occupation (medical or nonmedical), and the occupations of the respondent's family members, relatives, and friends had no statistical significance on the risk perception of COVID-19 infection (P > 0.05, Table 2). A chi-square test was performed regarding the risk perception of COVID-19 infection among the sexes: specifically, 36.80% of the men chose "no risk at all" compared to 27.74% of the women; 17.60% of the men chose "basically no risk" compared to 10.62% of the women; and 53.08% of the women chose "unclear" compared to 35.20% of the men (p<0.05; Table 3).

Perceptions of the Impact of COVID-19 Infection on Rheumatic Disease

Among the participants, 64 (15.35%) thought that even if they were infected with COVID-19, it would have no impact on their rheumatic disease, 30 (7.19%) thought it would have a negligible impact, 20 (4.8%) thought it would have a moderate impact, 29 (6.95%) thought it would have a considerable impact, 27 (6.47%) thought it would have an enormous impact, and 247 (59.23%) were not certain about the impact (Table 4). The results of ANOVA showed that the occupation (medical or nonmedical) of the respondents was significantly associated with the impact of COVID-19

Table 2 Analysis of the Impact of Demographic Details on the Perception of COVID-19 Infection Risk

Items	Variables	Number	Mean ± SD	F	p
Sex	Male	125	3.18±2.21	11.288	0.001
	Female	292	3.98±2.26		
Age	18–29	39	3.21±2.17	0.985	0.427
	30–39	77	3.56±2.21		
	40–49	123	4.02±2.28		
	50–59	122	3.82±2.28		
	60–65	39	3.64±2.39		
	65 and older	17	3.47±2.48		
Marital status	Married	376	3.77±2.28	0.852	0.427
	Unmarried	33	3.27±2.24		
	Divorced or widowed	8	4.13±2.23		
Place of residence	Cities	84	3.58±2.24	1.628	0.166
	Counties	96	3.89±2.28		
	Towns	32	3.16±2.30		
	Villages	104	4.06±2.30		
	No fixed place of residence	1	6.00±null		
Occupation	Medical	19	3.26±2.16	0.878	0.349
	Nonmedical	398	3.76±2.28		
Occupations of family members, relatives, and friends	Medical	124	3.76±2.21	0.010	0.921
	Nonmedical	293	3.73±2.30		

Table 3 Analysis of the Impact of Sex on the Perception of COVID-19 Infection Risk

Questions	Options	Sex: n (%)		Total	χ^2	p
		Male	Female			
What do you think your risk of infection with COVID-19 is?	No risk at all	46(36.80)	81(27.74)	127(30.46)	13.641	0.018
	Negligible risk	22(17.60)	31(10.62)	53(12.71)		
	Medium risk	10(8.00)	14(4.79)	24(5.76)		
	Considerable risk	2(1.60)	7(2.40)	9(2.16)		
	Extremely high risk	1(0.80)	4(1.37)	5(1.20)		
	Unclear	44(35.20)	155(53.08)	199(47.72)		
Total		125	292	417		

infection on rheumatic disease (P <0.05); however, sex, age, marital status, place of residence, occupations of the respondent's family members, relatives, and friends (medical or nonmedical), and the perception of the impact of COVID-19 infection on rheumatic disease were not statistically significant (P > 0.05). Chi-square test analysis showed that 31.58% and 26.32% of the participants who were medical workers chose "no impact at all" and "unclear", respectively, compared to 14.57% and 60.89% of nonmedical workers, respectively (P <0.05; Table 5).

Factors Influencing the Willingness to Receive COVID-19 Vaccination

Among the 417 collected questionnaires regarding COVID-19 vaccination willingness, 38 (9.11%) of the participants completely rejected vaccination, 5 (1.20%) were uncertain but inclined to reject vaccination, 7 (1.68%) were partially inclined to reject vaccination, and 52 (12.47%) wanted to postpone vaccination. In contrast, 21 (5.04%) of the participants partially intended to accept vaccination, 26 (6.24%) intended to accept vaccination but were also unsure, and 268 (64.27%) were willing to accept vaccination.

Table 4 ANOVA Between Demographic Details and the Perception of the Impact of COVID-19 Infection on Rheumatic Disease

Items	Variables	Number	Mean ± SD	F	p
Sex	Male	125)	4.33±2.06	3.419	0.065
	Female	292	4.71±1.89		
Age	18–29	39	4.49±1.79	0.923	0.466
	30–39	77	4.78±1.74		
	40–49	123	4.63±1.99		
	50–59	122	4.60±1.99		
	60–65	39	4.05±2.24		
	65 and older	17	5.00±1.94		
Marital status	Married	376	4.61±1.97	2.487	0.084
	Unmarried	33	4.18±1.88		
	Divorced or widowed	8	5.88±0.35		
Educational level	Junior high school and below	189	4.56±2.06	0.239	0.787
	High school or vocational school	115	4.70±1.95		
	College and above	113	4.56±1.77		
Place of residence	Cities	184	4.50±1.92	1.344	0.253
	Counties	96	4.57±2.00		
	Towns	32	4.16±2.22		
	Villages	104	4.91±1.84		
	No fixed place of residence	1	6.00±null		
Occupation	Medical	19	3.53±2.09	6.074	0.014
	Nonmedical	398	4.65±1.93		
Occupations of family members, relative, and friends	Medical	124	4.48±1.87	0.682	0.409
	Nonmedical	293	4.65±1.99		

Table 5 Chi-Square Analysis Between the Occupations (Medical versus Nonmedical) of the Participants and Their Perceptions of the Impact of COVID-19 Infection on Rheumatic Disease

Questions	Options	Occupation (%)		Total	χ^2	p
		Medical	Nonmedical			
How much do you think your rheumatic disease will be affected if you are infected with COVID-19?	No impact at all	6(31.58)	58(14.57)	64(15.35)	11.557	0.041
	Negligible impact	1(5.26)	29(7.29)	30(7.19)		
	Medium impact	2(10.53)	18(4.52)	20(4.80)		
	Considerable impact	2(10.53)	27(6.78)	29(6.95)		
	Extremely tremendous impact	3(15.79)	24(6.03)	27(6.47)		
	Unclear	5(26.32)	242(60.80)	247(59.23)		
Total		19	398	417		

Analysis of the Factors Influencing COVID-19 Vaccine Willingness

Logistic linear regression analysis showed that sex, the occupations of the respondents, their family members, relatives, and friends (medical or nonmedical), and the perception of the impact of COVID-19 infection on rheumatic disease had a statistically significant effect on the willingness to receive the COVID-19 vaccine (P <0.05; Table 6). ANOVA was performed regarding the degree of vaccination willingness and the four factors influencing vaccination willingness. Sex, occupation, the perception of the impact of COVID-19 infection on rheumatic disease, and vaccination willingness were analyzed by ANOVA (P <0.05) as follows: males (6.35±1.30) were more willing than females (5.55±2.12) to receive vaccination, nonmedical workers (5.84±1.89) were more willing than medical workers (4.63±2.65) to receive vaccination,

Table 6 Logistic Regression Analysis of Factors Influencing COVID-19 Vaccine Willingness

Variables	β	p	OR	VIF	95% CI
Sex	−0.201	0.000	−0.851	1.092	−1.260 ~ −0.441
Age	0.028	0.606	0.043	1.285	−0.121~0.207
Marital status	−0.058	0.251	−0.297	1.129	−0.803~0.209
Place of residence	−0.007	0.899	−0.011	1.329	−0.179~0.157
Occupation	0.173	0.001	1.609	1.110	0.702~2.516
Occupations of family members, relatives, and friends	−0.098	0.049	−0.416	1.108	−0.829 ~ −0.002
Disease assessment	0.016	0.732	0.087	1.037	−0.411~0.585
Perception of COVID-19 infection risk	−0.018	0.760	−0.016	1.632	−0.117~0.085
Perception of the impact of COVID-19 infection on rheumatic disease	−0.154	0.012	−0.154	1.683	−0.273 ~ −0.034
Perception of the impact of COVID-19 vaccination on rheumatic disease	0.084	0.088	0.068	1.071	−0.010~0.145
Vaccination with other vaccines in the last 5 years (other than the COVID-19 vaccine)	−0.045	0.360	−0.292	1.073	−0.917~0.332
Sample size	417				
R^2	0.100				
Adjusted R^2	0.074				
F value	F (12,404)=3.754, p=0.000				

Note: Dependent variable: willingness to be vaccinated against COVID-19. *D-W* value: 1.831.

and patients who thought COVID-19 infection had no impact on rheumatic disease (6.58±1.48) were more willing than those who were uncertain about vaccination (5.72±2.04) to receive vaccination; the OR values were negatively correlated (Table 7).

Analysis of COVID-19 Vaccination

Among the 417 participants, 167 (44.60%) received the COVID-19 vaccine, and 231 (55.40%) did not. Of the 167 patients in the vaccinated group, 152 (91.02%) had no adverse reactions, while 15 (8.98%) had adverse reactions, including 3 with mild pain at the injection site, 3 with aggravated joint pain, 2 with mild dizziness, 2 with mild nausea, 2 with mild abdominal pain, 2 with mild rash, and 1 with a runny nose. Of the patients in the unvaccinated group, 245 options chose not to be vaccinated. The respondents were permitted to choose more than one option. Fourteen responses (5.71%) did not understand the vaccination process or found it to be too troublesome, 13 (5.31%) found it difficult to make an appointment due to the shortage of vaccines, 2 (0.82%) were not satisfied with the preventive effect of the vaccine, 44 (17.96%) were worried about the quality or side effects of the vaccine, 12 (4.90%) claimed their vaccinations had been scheduled but it was not time for the appointment, 117 (47.76%) thought they did not belong to the population that needed to be vaccinated, and 43 (17.55%) chose other reasons.

Table 7 ANOVA of the Degree of Willingness and Factors Influencing the Degree of Willingness to Be Vaccinated Against COVID-19

Items	Variables	Number	Mean ± SD	F	p
Sex	Male	125	6.35±1.30	15.503	0.000
	Female	292	5.55±2.12		
Occupation	Medical	19	4.63±2.65	7.164	0.008
	Nonmedical	398	5.84±1.89		
Occupations of family members, relatives, and friends	Medical	124	5.94±1.91	1.003	0.317
	No-medical	293	5.73±1.96		
Perception of the impact of COVID-19 infection on rheumatic disease	No impact at all	64	6.58±1.48	5.161	0.000
	Negligible impact	30	6.33±1.15		
	Medium impact	20	5.10±2.45		
	Considerable impact	29	5.55±1.72		
	Tremendous impact	27	4.70±1.81		
	Unclear	247	5.72±2.04		

Discussion

The results of this questionnaire survey showed that different sexes had different risk perceptions regarding COVID-19 infection. The proportion of men who thought there was no risk at all and that the risk was negligible was greater than that of women, while the proportion of women who chose "unclear" was greater than that of men, which indicated that men tend to underestimate the risk perception of COVID-19 infection, while women lack awareness of the risk of COVID-19 infection. There was a difference between medical workers and nonmedical workers in the perception of the impact of COVID-19 infection on rheumatic disease. The proportion of medical workers who thought there was no impact was 31.58%, which was greater than that of nonmedical workers (14.57%). The proportion of nonmedical workers who were unclear about the level of impact was 60.80%, which was greater than that of medical workers (26.32%). These results suggested that a large number of people are still unaware of or lack knowledge about the impact of COVID-19 infection on rheumatic disease, while a very high proportion of medical workers believe that there is no impact at all. A multicenter study showed that female sex, a fear of being infected, and the nursing profession are the main factors affecting vaccination for the population with mental health disturbances.[12] Another study among adult participants found that males have a poor perception of the risk of COVID-19 and do not practice self-quarantining.[13] Our results showed that sex and the medical profession have a significant impact on the perception of COVID-19 infection risk, which is consistent with published reports.[12–15]

Among unvaccinated patients with rheumatic disease, 64.27% were completely willing to be vaccinated against COVID-19, while 26.62% were hesitant. The factors that influenced willingness to vaccinate included sex, occupation, and the perception of the impact of COVID-19 infection on rheumatic disease. The vaccination willingness of male patients was higher than that of female patients, and the vaccination willingness of nonmedical workers was higher than that of medical workers. The survey results by Yurttas et al compared the willingness to be vaccinated among the healthy population, patients with rheumatic diseases and medical workers and found that males and medical workers were more willing to be vaccinated.[16] Therefore, clinically, male patients with rheumatic diseases are more likely to be persuaded to be vaccinated. The perception of the impact of COVID-19 infection on rheumatic disease was negatively correlated with vaccination willingness. The greater a patient thought of the impact of COVID-19 vaccines, the lower their vaccination willingness, which was consistent with the results of previous research.[17–20] High perceived susceptibility to COVID-19 also makes people more inclined to receive a COVID-19 vaccine.[10] A survey in 2021 shows that only 54.9% of patients with rheumatic and musculoskeletal diseases were willing to receive the COVID-19 vaccine, although they perceived themselves to be at risk of being infected.[21] Similar to the survey,[21] 64.27% of the patients with rheumatic disease in our study were willing to receive the vaccine, which indicates that their concept of vaccination should be improved.

In this survey, 167 patients (44.60%) with rheumatic disease received the COVID-19 vaccine. Looking at the management experience of other infectious diseases, herd immunity can help vaccination programs and protect unvaccinated, immuno-compromised populations.[22] A vaccination rate of 70%-80%, or more, will be effective in achieving herd immunity.[22] A vaccination rate of 60–72% is recommended for herd immunity, although a rate of 84–90% is much better.[23] The adverse reactions in the unvaccinated patients were mild pain at the injection site, dizziness, nausea, rash, a runny nose, and aggravated joint pain, which were general adverse reactions. As reported, pain, headache, and fatigue were the most frequent adverse reactions to COVID-19.[24] Our results did not differ from the existing reports. The incidence of adverse reactions was 8.98%, which was higher than that in the COVID-19 vaccine surveillance report (11.86/100,000 doses) released by the China CDC on May 28, 2021.[25] The relatively high rate of adverse reactions may be due to the relatively low immunity of patients with rheumatic disease. The reaction to the vaccine would be intensified, but because there were no serious adverse reactions, it can be concluded that the safety of the vaccine is relatively high. Among the unvaccinated participants, as many as 47.76% said that they did not receive the vaccine because they did not think they were among the population that needed to be vaccinated. This finding is closely related to a person's perception of COVID-19, as previously reported.[18–20]

The global COVID-19 pandemic has not been controlled, and there have been many local outbreaks in China. Only when the vaccination rate reaches the level of herd immunity can the disease be controlled.[23] Due to the characteristics of rheumatic disease, such as multisystem damage, repeated recurrence, long-term survival of patients with the disease, and massive application of immunosuppressive drugs, a number of vaccination guidelines and expert opinions have been published for this special population with rheumatic immune diseases at home and abroad.[8,26] Patients with rheumatic disease are more

susceptible to COVID-19 infection than the general population, have a high mortality rate and are very likely to have adverse reactions.[8,26] The experts suggest that these patients should receive vaccines as early as possible, while adjusting their therapies against rheumatic disease;[8,26] however, a patient's low awareness of the risk of COVID-19 infection and vaccination and excessive anxiety about the disease have led to low vaccination willingness and a low vaccination rate.[17–20] Indeed, the publicity of professional medical knowledge should be enhanced. With the help of health care experts and social media, health communication campaigns should be improved and populations at risk should be targeted.[27] We should provide verified communication from physicians' offices to the public via multiple channels, such as the internet, newspapers, radio, television, popular medical science platforms, and health education programs, to eliminate hesitation for vaccination and comprehensively enhance confidence in vaccination.[28] Under the requirement of herd immunity against COVID-19 infection, it is even more important to strengthen international cooperation, play a leading role in the government, and strengthen the quality control of COVID-19.[29] According to our results and previous reports,[17–20,23–29] we should improve the perception and education of patients with low immune capacity, thereby improving their vaccination willingness, achieving safe vaccination, accomplishing herd immunity as soon as possible, and avoiding the health hazards aggravated by COVID-19.

A limitation of this study was that this was a single-center small sample survey, so it is still necessary to expand the sample size to verify the results.

Conclusion

The sex of patients with rheumatoid diseases, whether they were medical workers or not, the level of knowledge about the risk of COVID-19 infection and the impact of vaccination on the disease were shown to be key factors influencing patients' willingness to receive a COVID-19 vaccine. The vaccination rate of patients with rheumatic disease was correspondingly low, and the rate of adverse reactions was slightly higher than that in the general population.

Disclosure

The authors report no conflicts of interest in this work.

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