

## Antibody response to the Janssen/Johnson & Johnson SARS-CoV-2 vaccine in patients with rheumatic and musculoskeletal diseases

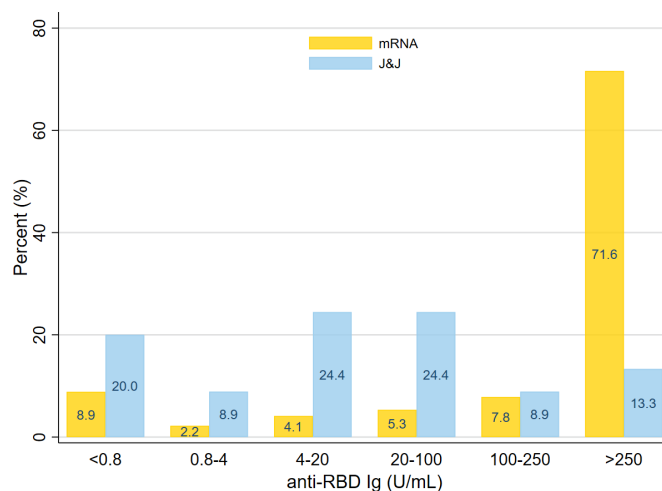
In immunocompetent populations, the Janssen/Johnson & Johnson (J&J) SARS-CoV-2 vaccine induces antibody, CD4 + and CD8+ T cell responses and offers protection against severe and symptomatic SARS-CoV-2 infection.<sup>1,2</sup> This vaccine is an adenovirus serotype 26 (Ad26) vector expressing a stabilised SARS-CoV-2 spike (S) (Ad26.COV2.S), a platform without prior approval for use in the general population, or for patients with rheumatic and musculoskeletal diseases (RMD).<sup>3</sup> Patients on immunosuppressive therapy were excluded from the clinical trials<sup>1,2</sup> and early data have suggested that the J&J vaccine results in lower humoral immunity than mRNA vaccination in immunosuppressed transplant patients.<sup>4</sup> Given the attenuated immunogenicity to mRNA-based SARS-CoV-2 vaccines in certain patients with RMD,<sup>5</sup> we studied the anti-spike antibody response to J&J SARS-CoV-2 vaccination in patients with RMD and compared them to recipients of the mRNA series.

We used our prospective cohort of patients with RMD who underwent SARS-CoV-2 vaccination between December 2020 and May 2021.<sup>5</sup> We collected information on demographics, rheumatic diagnoses and immunosuppressive medications. One month following completion of vaccine series (J&J or mRNA), serologic testing on the semi-quantitative Roche Elecsys anti-SARS-CoV-2 S enzyme immunoassay, which tests for antibodies against the receptor binding domain (RBD) of the SARS-CoV-2 S protein, was completed.

We compared the percentage of participants with detectable anti-RBD antibody in the J&J group (n=45) to the mRNA group (n=994) using Fisher's exact test (online supplemental table 1). We compared the two vaccine platforms using logistic regression adjusting for age, sex, race and use of mycophenolate, rituximab, glucocorticoid and methotrexate. We compared anti-RBD titres of the J&J group to those of the mRNA group using Wilcoxon rank-sum test.

At a median (IQR) of 29 days (28-32) after vaccination, anti-RBD antibody was detectable in 36 participants who received the J&J vaccine compared with 906 who completed the mRNA vaccine series (80% vs 92%, p=0.03). Those who received J&J vaccination had a higher odds of negative antibody response (OR: 2.57, 95%CI 1.20 to 5.52, p=0.01) compared with those who completed the mRNA series. This association remained statistically significant in the adjusted logistic regression model (aOR: 3.86, 95%CI 1.37 to 10.84 p=0.01). Consistent with prior findings, use of rituximab, mycophenolate and glucocorticoids had a statistically significant association with negative antibody response (online supplemental table 2).<sup>5</sup> Median anti-RBD antibody titres in the J&J group were lower than the mRNA group (9.7 vs 250 U/mL; p<0.001) (figure 1).

In this observational study, we found that patients with RMD who received J&J vaccination had a lower rate of seroconversion compared with recipients of the mRNA series. One in five participants who received J&J vaccination did not mount a detectable antibody response. In those with a detectable antibody response, participants who received the J&J vaccine had lower antibody titres than the mRNA group. While no cut-off titre has been defined to associate with protection, there is a well-recognised role of neutralising antibodies in protection against SARS-CoV-2 infection. A recent study estimated that an



**Figure 1** SARS-CoV-2 anti-RBD antibody titres among recipients of mRNA vs J&J vaccine. Titres could range from <0.4 U/mL to >250 U/mL. Positive antibody is defined as an anti-SARS-CoV-2 RBD antibody titre >0.79 U/mL. Ig, immunoglobulin; J&J, Johnson & Johnson; RBD, receptor binding domain.

antibody neutralisation level for 50% protection against detectable SARS-CoV-2 infection to be 20% of the mean convalescent level.<sup>6</sup>

Limitations of this study include small sample size and non-randomised design. We did not analyse peri-vaccination immunosuppression dosing or timing.

These early results suggest that patients with RMD who receive the J&J vaccine may have a more limited humoral response to J&J SARS-CoV-2 vaccination than recipients of the mRNA vaccine series. Optimisation of J&J vaccine response in patients with RMD requires additional studies with larger sample size and evaluation of deeper immunophenotyping, including memory B cell and T cell responses.

### PATIENT AND PUBLIC INVOLVEMENT

Patients were not involved in the design, conduct or dissemination of the study, though this study was motivated by questions frequently posed by the patients. The study has a public website (<https://vaccineresponse.org/>) and email account where we welcomed participants and the public to contact the research team. Results of the study will be shared with national RMD organisations for dissemination to their patient communities once published.

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**Supplemental Table 1.** Clinical characteristics of RMD participants stratified by vaccine type (mRNA or J&J)

	<b>mRNA (n=994)</b>	<b>J&amp;J (n=45)</b>	<b>p-value</b>
Age, median (IQR)	46.3 (37, 58)	47.3 (41, 56)	0.47
Male sex, no. (%)	58 (5.8%)	6 (13.3%)	0.08
Days from D2 to testing, median (IQR)	29.0 (28.0, 33.0)	29.0 (28.0, 32.0)	0.81
Non-white, no. (%)	104 (10.5%)	1 (2.2%)	0.25
Diagnosis, no. (%)			0.23
Inflammatory arthritis <sup>1</sup>	442 (44.5%)	19 (42.2%)	
Overlap connective tissue disease <sup>2</sup>	213 (21.5%)	7 (15.5%)	
Systemic lupus erythematosus	206 (20.7%)	10 (22.2%)	
Sjögren's syndrome	49 (4.9%)	7 (15.5%)	
Myositis	53 (5.3%)	1 (2.2%)	
Vasculitis <sup>3</sup>	21 (2.1%)	1 (2.2%)	
Systemic sclerosis	10 (1%)	0 (0%)	
Therapy included in regimen, no. (%) <sup>4</sup>			
Azathioprine	77 (7.7%)	1 (2.2%)	0.36
Hydroxychloroquine	414 (41.6%)	16 (35.5%)	0.42
Leflunomide	47 (4.7%)	4 (8.8%)	0.13
Methotrexate	255 (25.7%)	12 (26.6%)	0.85
Tacrolimus	15 (1.5%)	1 (2.2%)	0.46
Mycophenolate	145 (14.6%)	4 (8.8%)	0.64
Abatacept	38 (3.8%)	1 (2.2%)	>0.9
Belimumab	114 (11.5%)	6 (13.3%)	0.80
Interleukin inhibitor <sup>5</sup>	67 (6.7%)	2 (4.4%)	>0.9
Rituximab	58 (5.8%)	4 (8.8%)	0.29

TNF inhibitor	239 (24.0%)	9 (20.0%)	0.71
Tofacitinib	62 (6.2%)	2 (4.4%)	>0.9
Glucocorticoids <sup>6</sup>	295 (29.7%)	10 (22.2%)	0.38
Immunomodulatory <sup>7</sup>	47 (4.7%)	1 (2.2%)	>0.9
Combination therapy <sup>8</sup>	517 (52.0%)	19 (42.2%)	0.59

**1** Rheumatoid arthritis, ankylosing spondylitis, psoriatic arthritis, reactive arthritis, or inflammatory bowel disease associated arthritis

**2** Denotes a combination of two or more of the rheumatic conditions

**3** Polyarteritis nodosa, Behcet's syndrome, polymyalgia rheumatica, temporal arteritis, eosinophilic granulomatosis polyangiitis, granulomatous polyangiitis, Henoch-Schonlein purpura, microscopic polyangiitis, or Takayasu arteritis

**4** Participants could select more than 1 option thus sum is greater than 100%

**5** Interleukin inhibitors include ixekizumab, secukinumab, tocilizumab and ustekinumab.

**6** Glucocorticoids includes prednisone and prednisone equivalents.

**7** Immunomodulatory includes intravenous immunoglobulin (IVIg) and subcutaneous Immunoglobulin (SCIg).

**8** Denotes a combination of conventional DMARD, biologic, corticosteroid, or immunomodulatory therapy

**Supplemental Table 2.** Adjusted odds ratio of having a negative anti-spike antibody response at one month following completion of vaccination series.

	aOR (95% CI)	p-value
<b>Vaccine, J&amp;J</b>	<b>3.9 (1.4, 10.8)</b>	<b>0.01</b>
Age (per 10 year)	1.1 (1.00, 1.2)	0.10
Sex, male	0.4 (0.1, 2.0)	0.3
Race, nonwhite	0.9 (0.41, 2.0)	0.8
Rituximab use	43.4 (21.6, 87.3)	<0.001
Glucocorticoid use	2.7 (1.6, 4.6)	<0.001
Mycophenolate use	8.9 (4.8, 16.6)	<0.001
Methotrexate use	1.2 (0.6, 2.45)	0.7