

Supplementary Material to: “Impact of vaccination on post-acute sequelae of SARS CoV-2 infection in patients with rheumatic diseases” by Patel, et al

Supplementary Table 1. Persistent COVID-19 symptoms and other patient-reported outcomes in rheumatic disease patients following COVID-19 infection among those who completed surveys within 6 months of COVID-19 infection.

	All rheumatic disease patients (N=147)	Breakthrough COVID-19 infection (N=106)	Non-breakthrough COVID-19 infection (N=41)	p-value
Days to acute symptom resolution or date of survey if symptoms ongoing, median [IQR]	21 (8, 60)	21 (8, 56)	25 (10, 91)	0.23
CDC Definition of PASC (COVID-19 symptoms lasting at least 28 days post-COVID-19 infection)	66 (45)	46 (43)	20 (49)	0.58
WHO Definition of PASC (COVID-19 symptoms lasting at least 90 days post-COVID-19 infection)*	21 (29)	9 (24)	12 (33)	0.40
Pain (SF-MPQ)				
N	139	101	38	
Median score [IQR]	4 (1, 9)	4 (1, 9)	4.5 (2, 9)	0.62
Pain rating index ordinal categories, n (%)				0.20
No pain	24 (16)	14 (13)	10 (24)	
Mild pain	47 (32)	37 (35)	10 (24)	
Discomforting, distressing, horrible, or excruciating pain	69 (47)	50 (47)	19 (46)	
Fatigue (FSI)				
N	140	101	39	
Median score [IQR]	54 (25, 82.5)	51 (23, 81)	58 (27, 85)	0.35
Functional status (mHAQ)				
N	142	103	39	
Median score [IQR]	0.1 (0, 0.5)	0.1 (0, 0.5)	0.1 (0, 0.4)	0.51
Functional status categorical score, n (%)				1.00
Normal (<0.3)	89 (61)	64 (60)	25 (61)	
Mild, moderate, or severe (0.3 to >1.8)	53 (36)	39 (37)	14 (34)	
Health status (SF-12)				
PCS-12 score, median [IQR]	42.3 (33.4, 51.1)	43.6 (33.4, 52.5)	40.8 (33.4, 47.5)	0.43
MCS-12 score, median [IQR]	49.2 (39.4, 55.5)	49 (41.3, 55)	49.9 (35.8, 57.6)	0.79

CDC, Centers for Disease Control and Prevention; WHO, World Health Organization; FSI, Fatigue Symptom Inventory; mHAQ, modified Health Assessment Questionnaire; SF-12, Short-form 12-item

survey; SF-MPQ, Short-form McGill Pain Questionnaire; PCS-12, Physical Component Summary score; MCS-12, Mental Component Summary score

*Denominator includes those who completed a survey at least 90 days following COVID-19 diagnosis; N=73 overall, 37 with breakthrough infection, and 36 with non-breakthrough infection

Supplementary Table 2. Persistent COVID-19 symptoms and other patient-reported outcomes in rheumatic disease patients following COVID-19 infection among those who did not receive either monoclonal antibodies or nirmatrelvir/ritonavir

	All rheumatic disease patients (N=214)	Breakthrough COVID-19 infection (N=64)	Non-breakthrough COVID-19 infection (N=150)	p-value
Days to acute symptom resolution or date of survey if symptoms ongoing, median [IQR]	30 (10, 120)	25 (8, 57)	30 (12, 216)	0.01
CDC Definition of PASC (COVID-19 symptoms lasting at least 28 days post-COVID-19 infection)	108 (50)	27 (42)	81 (54)	0.14
WHO Definition of PASC (COVID-19 symptoms lasting at least 90 days post-COVID-19 infection)*	60 (35)	3 (9)	57 (51)	0.01
Pain (SF-MPQ)				
N	193	60	133	
Median score [IQR]	5 (2, 10)	3 (1, 7)	6 (3, 10)	0.02
Pain rating index ordinal categories, n (%)				0.05
No pain	31 (14)	8 (13)	23 (15)	
Mild pain	64 (30)	27 (42)	37 (25)	
Discomforting, distressing, horrible, or excruciating pain	102 (48)	25 (39)	77 (51)	
Fatigue (FSI)				
N	199	60	139	
Median score [IQR]	51 (25, 80)	36 (14, 68)	55 (28, 84)	0.02
Functional status (mHAQ)				
N	205	61	144	
Median score [IQR]	0.1 (0.0, 0.4)	0.1 (0.0, 0.4)	0.2 (0.0, 0.5)	0.42
Functional status categorical score, n (%)				0.08
Normal (<0.3)	128 (60)	44 (69)	84 (56)	
Mild, moderate, or severe (0.3 to >1.8)	77 (36)	17 (27)	60 (40)	
Health status (SF-12)				
PCS-12 score, median [IQR]	42.3 (32.8, 51.0)	44.6 (36.4, 53.9)	41.1 (32.1, 49.9)	0.09
MCS-12 score, median [IQR]	49.9 (39.1, 56.3)	49.1 (39.7, 56.0)	50.7 (37.8, 57.1)	0.98

CDC, Centers for Disease Control and Prevention; WHO, World Health Organization; FSI, Fatigue Symptom Inventory; mHAQ, modified Health Assessment Questionnaire; SF-12, Short-form 12-item survey; SF-MPQ, Short-form McGill Pain Questionnaire; PCS-12, Physical Component Summary score; MCS-12, Mental Component Summary score

*Denominator includes those who completed a survey at least 90 days following COVID-19 diagnosis; N=171 overall, 26 with breakthrough infection, and 145 with non-breakthrough infection

Supplementary Table 3. Persistent COVID-19 symptoms and other patient-reported outcomes in rheumatic disease patients following COVID-19 infection among those who did not receive any COVID-19-specific therapy.

	All rheumatic disease patients (N=192)	Breakthrough COVID-19 infection (N=60)	Non-breakthrough COVID-19 infection (N=132)	p-value
Days to acute symptom resolution or date of survey if symptoms ongoing, median [IQR]	25 (10, 92)	23 (8, 57)	28 (12, 200)	0.02
CDC Definition of PASC (COVID-19 symptoms lasting at least 28 days post-COVID-19 infection)	90 (47)	24 (40)	66 (50)	0.22
WHO Definition of PASC (COVID-19 symptoms lasting at least 90 days post-COVID-19 infection)*	48 (32)	3 (8)	45 (40)	0.03
Pain (SF-MPQ)				
N	174	57	117	
Median score [IQR]	5 (2, 10)	3 (1, 7)	6 (3, 11)	0.02
Pain rating index ordinal categories, n (%)				0.02
No pain	27 (14)	7 (12)	20 (15)	
Mild pain	58 (30)	27 (45)	31 (23)	
Discomforting, distressing, horrible, or excruciating pain	93 (48)	23 (38)	70 (53)	
Fatigue (FSI)				
N	180	57	123	
Median score [IQR]	49 (24, 80)	33 (13, 66)	54 (27, 84)	0.04
Functional status (mHAQ)				
N	184	57	127	
Median score [IQR]	0.1 (0.0, 0.4)	0.1 (0.0, 0.4)	0.1 (0.0, 0.5)	0.25
Functional status categorical score, n (%)				0.07
Normal (<0.3)	117 (61)	42 (70)	75 (57)	
Mild, moderate, or severe (0.3 to >1.8)	67 (35)	15 (25)	52 (39)	
Health status (SF-12)				
PCS-12 score, median [IQR]	42.7 (33.2, 51.7)	45.5 (36.4, 54.0)	41.1 (32.6, 50.3)	0.14
MCS-12 score, median [IQR]	50.9 (39.3, 57.0)	49.4 (39.6, 56.0)	51.3 (38.0, 57.6)	0.90

CDC, Centers for Disease Control and Prevention; WHO, World Health Organization; FSI, Fatigue Symptom Inventory; mHAQ, modified Health Assessment Questionnaire; SF-12, Short-form 12-item survey; SF-MPQ, Short-form McGill Pain Questionnaire; PCS-12, Physical Component Summary score; MCS-12, Mental Component Summary score

*Denominator includes those who completed a survey at least 90 days following COVID-19 diagnosis; N=152 overall, 24 with breakthrough infection, and 128 with non-breakthrough infection

Supplementary Table 4. Persistent COVID-19 symptoms and other patient-reported outcomes in rheumatic disease patients following COVID-19 infection among those who did not require hospitalization for COVID-19 infection.

	All rheumatic disease patients (N=244)	Breakthrough COVID-19 infection (N=110)	Non-breakthrough COVID-19 infection (N=134)	p-value
Days to acute symptom resolution or date of survey if symptoms ongoing, median [IQR]	21 (10, 84)	21 (8, 51)	25 (10, 176)	0.01
CDC Definition of PASC (COVID-19 symptoms lasting at least 28 days post-COVID-19 infection)	112 (46)	46 (42)	66 (49)	0.25
WHO Definition of PASC (COVID-19 symptoms lasting at least 90 days post-COVID-19 infection)*	57 (33)	10 (23)	47 (36)	0.12
Pain (SF-MPQ)				
N	224	106	118	
Median score [IQR]	4 (2, 10)	4 (1, 8)	5 (2, 10)	0.15
Pain rating index ordinal categories, n (%)				
No pain	35 (14)	16 (15)	19 (14)	0.53
Mild pain	77 (32)	41 (37)	36 (27)	
Discomforting, distressing, horrible, or excruciating pain	116 (48)	49 (45)	67 (50)	
Fatigue (FSI)				
N	230	106	124	
Median score [IQR]	52 (25, 81)	49 (21, 79)	54 (28, 84)	0.18
Functional status (mHAQ)				
N	235	106	129	
Median score [IQR]	0.1 (0.0, 0.5)	0.1 (0.0, 0.5)	0.1 (0.0, 0.4)	0.62
Functional status categorical score, n (%)				
Normal (<0.3)	145 (59)	66 (60)	79 (59)	0.87
Mild, moderate, or severe (0.3 to >1.8)	90 (37)	40 (36)	50 (37)	
Health status (SF-12)				
PCS-12 score, median [IQR]	42.8 (33.6, 51.7)	43.6 (33.7, 53.5)	42.2 (33.4, 50.3)	0.48
MCS-12 score, median [IQR]	49.9 (39.3, 56.0)	49.0 (41.3, 55.4)	51.2 (36.7, 57.7)	0.98

CDC, Centers for Disease Control and Prevention; WHO, World Health Organization; FSI, Fatigue Symptom Inventory; mHAQ, modified Health Assessment Questionnaire; SF-12, Short-form 12-item survey; SF-MPQ, Short-form McGill Pain Questionnaire

*Denominator includes those who had completed a survey at least 90 days following COVID-19 diagnosis; N=172 overall, 43 with breakthrough infection, and 129 with non-breakthrough infection

Supplementary Table 5. Patient-reported outcomes among patients with PASC following breakthrough versus non-breakthrough COVID-19 infection

Characteristic	All patients with PASC (N=137)	PASC following breakthrough COVID-19 infection (N=48)	PASC following non-breakthrough COVID-19 infection (N=89)	p-value
Pain (SF-MPQ)				
N	124	45	79	
Median score [IQR]	7 (3, 12)	6 (2, 13)	7 (3, 11)	0.74
Pain rating index ordinal categories, n (%)				0.32
No pain	12 (9)	2 (4)	10 (11)	
Mild pain	31 (23)	13 (27)	18 (20)	
Discomforting, distressing, horrible, or excruciating pain	83 (61)	30 (63)	53 (60)	
Fatigue (FSI)				
N	128	45	83	
Median score [IQR]	67 (36, 90.5)	66 (33, 89)	67 (36, 92)	0.66
Functional status (mHAQ)				
N	129	45	84	
Median score [IQR]	0.4 (0.0, 0.8)	0.3 (0.1, 0.8)	0.4 (0.0, 0.7)	0.32
Functional status categorical score, n (%)				0.85
Normal (<0.3)	64 (47)	23 (48)	41 (46)	
Mild, moderate, or severe (0.3 to >1.8)	65 (47)	22 (46)	43 (48)	
Health status (SF-12)				
Physical Component Summary (PCS-12) score, median [IQR]	38.3 (31.4, 47.4)	37.6 (31.5, 46.1)	38.8 (31.2, 48.1)	0.70
Mental Component Summary (MCS-12) score, median [IQR]	46.4 (38, 54.9)	45.5 (39.5, 54.0)	46.8 (36.7, 55.8)	0.63
Persistent symptoms at time of survey, n (%)				
Fatigue/malaise	39 (28)	16 (33)	23 (26)	0.43
Anosmia	25 (18)	6 (13)	19 (21)	0.25
Dysgeusia	22 (16)	5 (10)	17 (19)	0.23
Dyspnea and/or cough	15 (11)	4 (8)	11 (12)	0.57
Nasal congestion or rhinorrhea	17 (12)	8 (17)	9 (10)	0.29

Headache	20 (15)	11 (23)	9 (10)	0.07
Myalgias	16 (12)	8 (17)	8 (9)	0.26
Fever	3 (2)	0 (0)	3 (3)	0.55
Sore throat	5 (4)	2 (4)	3 (3)	1.00

SF-MPQ, Short-form McGill Pain Questionnaire; FSI, Fatigue Symptom Inventory; mHAQ, modified Health Assessment Questionnaire; SF-12, Short-form 12-item survey

Supplementary Table 6. Self-reported systemic rheumatic disease activity and flare following COVID-19 infection.

	All rheumatic disease patients (N=280)	Breakthrough COVID-19 infection (N=116)	Non-breakthrough COVID-19 infection (N=164)	p-value
Self-reported SARD flare after COVID-19, n (%)	115 (41)	46 (40)	69 (42)	0.71
Timing of self-reported SARD flare after COVID-19, n (%)				0.19
<1 week	32 (11)	17 (15)	15 (9)	
1-4 weeks	49 (18)	20 (17)	29 (18)	
4-12 weeks	26 (9)	7 (6)	19 (12)	
>12 weeks	8 (3)	2 (2)	6 (4)	
Participant global assessment of disease activity before COVID-19 onset, mean \pm SD	7.6 (2.3)	7.6 (2.4)	7.6 (2.3)	0.98
Participant global assessment of disease activity at time of survey, mean \pm SD	6.7 (2.7)	6.8 (2.5)	6.6 (2.8)	0.41
Disease activity by RAPID-3 at time of survey				
Median score [IQR]	3.0 (1.3, 4.7)	3.0 (1.3, 4.7)	3.3 (1.3, 4.7)	0.48
Categorical score, n (%)				0.86
Remission (0)	17 (6)	6 (5)	11 (7)	
Near remission (0.3-1.0)	37 (13)	17 (15)	20 (12)	
Low severity (1.3-2.0)	34 (12)	13 (11)	21 (13)	
Moderate severity (2.3-4.0)	84 (30)	31 (27)	53 (32)	
High severity (4.3-10.0)	82 (29)	29 (25)	53 (32)	

COVID-19, coronavirus disease 2019; RAPID3, Routine Assessment of Participant Index Data 3; SARD, systemic autoimmune rheumatic disease

Supplementary Figure 1. Days to symptom resolution in those with breakthrough versus non-breakthrough COVID-19 infection over 204-day follow-up period (Unadjusted Analysis)

A. Cumulative incidence curves for time to symptom resolution, comparing breakthrough versus non-breakthrough infection. B and C, mean post-symptom resolution time spans as the area under the cumulative incidence curves in those with breakthrough versus non-breakthrough infection, respectively, across 204 days of follow-up.

Supplementary Figure 2A. Days to symptom resolution in those with breakthrough versus non-breakthrough COVID-19 infection over 28-day follow-up period (Unadjusted Analysis)

A. Cumulative incidence curves for time to symptom resolution, comparing breakthrough versus non-breakthrough infection. B and C, mean post-symptom resolution time spans as the area under the cumulative incidence curves in those with breakthrough versus non-breakthrough infection, respectively, across 28 days of follow-up.

Supplementary Figure 2B. Days to symptom resolution in those with breakthrough versus non-breakthrough COVID-19 infection over 28-day follow-up period (Adjusted Analysis)

A. Cumulative incidence curves for time to symptom resolution, comparing breakthrough versus non-breakthrough infection. B and C, mean post-symptom resolution time spans as the area under the cumulative incidence curves in those with breakthrough versus non-breakthrough infection, respectively, across 28 days of follow-up.

Supplementary Figure 3A. Days to symptom resolution in those with breakthrough versus non-breakthrough COVID-19 infection over 90-day follow-up period (Unadjusted Analysis)

A. Cumulative incidence curves for time to symptom resolution, comparing breakthrough versus non-breakthrough infection. B and C, mean post-symptom resolution time spans as the area under the cumulative incidence curves in those with breakthrough versus non-breakthrough infection, respectively, across 90 days of follow-up.

Supplementary Figure 3B. Days to symptom resolution in those with breakthrough versus non-breakthrough COVID-19 infection over 90-day follow-up period (Adjusted Analysis)

A. Cumulative incidence curves for time to symptom resolution, comparing breakthrough versus non-breakthrough infection. B and C, mean post-symptom resolution time spans as the area under the cumulative incidence curves in those with breakthrough versus non-breakthrough infection, respectively, across 90 days of follow-up.