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Perceived Risk and Associated Shielding Behaviors in Patients With Rheumatoid Arthritis During the Coronavirus 2019 Pandemic

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Objective. To investigate the perceived risk of coronavirus disease 2019 (COVID-19) infection and outcomes as well as shielding practices among patients with rheumatoid arthritis (RA) during the COVID-19 pandemic.

Methods. We surveyed participants with RA in a large health care system between July 16 and November 8, 2020. Participants reported RA treatment, COVID-19 risk perception, and shielding practices (eg, masks, social distancing, and quarantining). We examined the association of demographic and disease-specific factors with risk perception and the association of risk perception with shielding practices.

Results. Of 494 participants, 195 (40%), 169 (34%), and 130 (26%) strongly agreed, agreed, or were uncertain/disagreed that their RA put them at higher risk for COVID-19 or poor outcomes, respectively. Younger age (odds ratio [OR]: 0.98), having a comorbidity (OR: 1.60), and biologic disease-modifying antirheumatic drug (bDMARD) use (OR: 1.75) were independently associated with a higher perceived risk. Among those who strongly agreed, agreed, or were uncertain/disagreed that they had greater risk, 165 (85%), 118 (70%), and 69 (53%), respectively, practiced all three shielding measures ($P < 0.0001$). Those who strongly agreed or agreed that they were at higher risk were more likely to use all three shielding practices (OR: 4.16 and 1.97, respectively). bDMARD use and glucocorticoid use were associated with using all three shielding measures (OR: 1.99 and 1.81, respectively).

Conclusion. Perception of COVID-19 risk among patients with RA varies substantially. Factors associated with perceived risk are different from those found to be associated with worse outcomes in observational studies. Greater perceived risk is associated with more strict shielding, which has implications for patient education and mental health.

INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic has strongly impacted the lives of patients living with rheumatoid arthritis (RA) because of concerns and uncertainties regarding their risk for infection and severe outcomes, which have contributed to anxiety, depression, and reduced well-being (1). Indeed, population-based studies suggest that patients with RA have as high as a 35% higher risk of COVID-19–related death than the general population in the United Kingdom and United States (2,3). Other studies (4,5) have produced conflicting results, but recommendations have consistently advised patients with RA to

continue their disease-modifying antirheumatic drugs (DMARDs) during the pandemic and follow the recommended shielding practices, including mask wearing and social distancing (6).

The risk of poor outcomes in patients with RA and COVID-19 has been attributed to several factors, including those observed in the general population (eg, older age, minority race/ethnicity, and greater comorbidity burden) as well as disease-specific features, including higher disease activity, glucocorticoid exposure, and the use of some DMARDs at the time of COVID-19 infection (7–11). In particular, certain biologic DMARDs (bDMARDs) (ie, tumor necrosis factor-inhibitors [TNFis]) may be associated with better outcomes (ie, less hospitalization), whereas others such as

rituximab may be associated with worse outcomes when compared with other treatments (7,10,11).

The association of these factors with COVID-19 risk perception and the association of risk perception with adherence to recommended shielding practices is not well described in RA. Understanding factors associated with risk perception among patients with RA can guide patient education campaigns. Shielding practices are particularly important to characterize because of their importance for reducing the risk of COVID-19 infection among patients with RA, in whom severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) vaccination may be less efficacious than expected because of DMARD use (12–14). Additionally, differences in shielding may confound associations between certain DMARDs and COVID-19 outcomes in observational studies. We sought to understand the association of patient and disease-specific factors with risk perception and to characterize shielding practices in participants with RA in the United States.

PATIENTS AND METHODS

Study population. In this cross-sectional study, we identified participants with RA at Mass General Brigham (MGB), a large, multicenter health care system in the greater Boston, Massachusetts, area. We identified participants using the MGB centralized data warehouse, the Research Patient Data Registry (RPDR) (15), on the basis of the use of at least one International Classification of Diseases, tenth revision, code for inflammatory arthritis (M05-M14) and at least one prescription for at least one of the following DMARDs of interest between January 1, 2019, and February 31, 2020: abatacept, TNFis, janus kinase inhibitors (JAKis), IL-6 inhibitors (IL-6is), or methotrexate. In this study, we included patients who self-reported a diagnosis of RA. We did not exclude participants who may have been exposed to one of these DMARDs of interest as well as other DMARDs (eg, hydroxychloroquine) during

this period. Similarly, we included participants in this study who may have discontinued DMARDs during the pandemic. The survey data analyzed here were included in a survey meant to evaluate the association of abatacept with the risk of COVID-19; the DMARDs of interest were selected within that context. The survey data reported here are novel and have not been reported previously. This study was approved by the MGB Institutional Review Board.

Survey. A survey adapted from the COVID-19 Global Rheumatology Alliance Patient Experience Survey was developed for administration in the MGB cohort (16). The Patient Experience Survey was developed by key stakeholders in the patient experience during the COVID-19 pandemic, including patients and patient-oriented organizations as well as clinicians. The survey used in this study asked participants about their rheumatic disease, medication use, COVID-19 diagnosis (if applicable), COVID-19 risk perception, and shielding practices (see Supplementary Material). It included up to 25 questions (if the patient had a history of COVID-19 infection) and took up to 10 to 15 minutes to complete. Risk perception was captured by evaluating how strongly participants agreed or disagreed (on a five-level scale that included strongly agree, agree, uncertain, disagree, and strongly disagree) with the following statement: "I am worried that my rheumatic condition or its treatment puts me at higher risk for COVID-19 or severe complications if I become infected." COVID-19 shielding practices assessed included social distancing, quarantine, and/or glove/mask use. Participants were also invited to provide an optional free-text response regarding any other information about their experience during the COVID-19 pandemic that they wished to share. The survey was only available in English to facilitate rapid dissemination and data collection. After receiving permission from their rheumatology provider, each patient was contacted by email or United States mail depending on their preferences and invited to complete the survey either by phone, by mail, or electronically using Research Electronic Data Capture survey tools hosted at MGB (17,18). The survey was conducted between July 16, 2020, and November 8, 2020.

Covariates and outcomes of interest. Patient-reported details regarding age, sex, race, DMARD use (categorized as a bDMARD, targeted synthetic DMARD [tsDMARD], or conventional synthetic DMARD [csDMARD]) and glucocorticoid use from the 6 months prior to the COVID-19 pandemic to the date of survey completion, and disease activity were collected in the survey. Disease activity at the time of survey completion was assessed on a scale of 0 to 100, in which 100 indicates "very well" controlled. Health care use and comorbidities were extracted from the MGB RPDR by linking the patient survey to the associated electronic medical record data. Comorbidity burden was estimated using the Charlson Comorbidity Index (CCI) (19). Outcomes of interest included COVID-19 risk perception, shielding practices, and free-text response themes. COVID-19 risk perception was treated as a three-level outcome ("strongly

agree," "agree," and "uncertain/disagree") based on agreement with the statement. We assessed the proportion of patients using all three shielding practices (masking/gloving, quarantining, and social distancing). Free-text data collected in the survey were reviewed by two reviewers, and codes were identified. After identifying codes, two reviewers categorized each response into at least one theme; discrepancies were resolved by consensus.

Statistical analysis. Categorical variables are presented as number (percentage), and continuous variables are reported as mean ± SD or median ± interquartile range (IQR), as appropriate. Univariate analyses were performed using T-tests or χ^2 tests,

as appropriate. Unadjusted and adjusted ordinal logistic regression was used to examine the association of potential risk factors for COVID-19 and severity with risk perception after confirming that the proportional odds assumption was met for each analysis. We used unadjusted and adjusted logistic regression to estimate the association of risk perception with shielding practices. We used unadjusted and adjusted logistic regression to estimate the association of bDMARD/tsDMARD use with shielding practices, excluding risk perception as a covariate because this is likely a mediator of this association. All P values were two-sided, with a significance threshold of less than 0.05. SAS Version 9.4 was used for all analyses.

Table 1. Demographics and characteristics of survey responders

	Overall (N = 494)	Strongly Agree (n = 195)	Agree (n = 169)	Uncertain/ Disagree (n = 130)	P Value (χ^2)
Age, mean (SD)	62.6 (13.8)	61.0 (13.1)	61.7 (14.3)	66.1 (13.8)	0.01
Sex, n (%)					0.8
Female	418 (84.6)	167 (85.6)	141 (83.4)	110 (84.6)	
Male	76 (15.4)	28 (14.4)	28 (16.6)	20 (15.4)	
Race, n (%)					0.2
Asian	12 (2.4)	3 (1.5)	3 (1.8)	6 (4.6)	
Black or African American	18 (3.6)	9 (4.6)	3 (1.8)	6 (4.6)	
Hispanic or Latino	2 (0.40)	2 (1.0)	0 (0.0)	0 (0.0)	
White	447 (90.5)	175 (89.7)	160 (94.7)	112 (86.2)	
Declined	6 (1.2)	1 (0.50)	1 (0.60)	4 (3.1)	
Unknown	1 (0.20)	1 (0.51)	0 (0.0)	0 (0.0)	
Other	8 (1.6)	4 (2.1)	2 (1.2)	2 (1.5)	
BMI, n (%)					0.8
<18.5	7 (1.4)	2 (1.0)	3 (0.6)	2 (1.5)	
18.5-24.9	180 (36.4)	69 (35.4)	58 (34.3)	53 (40.7)	
25.0-29.9	135 (27.3)	52 (26.7)	44 (26.0)	39 (30.0)	
>30	140 (28.3)	59 (30.3)	51 (30.2)	30 (23.1)	
Missing	32 (6.5)	13 (6.7)	13 (7.7)	6 (4.6)	
Smoking status, n (%)					0.9
Current	32 (6.5)	15 (7.7)	82 (42.1)	98 (50.3)	
Former	206 (41.7)	9 (5.3)	68 (40.2)	92 (54.4)	
Never	256 (51.8)	8 (6.2)	56 (43.1)	66 (50.1)	
Medications, n (%)					
Glucocorticoids	134 (17)	59 (30)	47 (28)	28 (22)	0.2
bDMARDs/tsDMARDs	385 (77.9)	163 (83.6)	134 (79.3)	88 (67.7)	0.01
csDMARDs	310 (62.7)	103 (52.8)	119 (70.4)	88 (67.7)	0.01
Comorbidities, n (%)					
Hypertension	142 (28.7)	66 (33.9)	41 (24.3)	35 (26.9)	0.1
Diabetes	22 (4.6)	8 (4.1)	7 (4.1)	7 (5.4)	0.8
Coronary artery disease	33 (6.7)	9 (4.6)	9 (5.3)	15 (11.5)	0.03
Heart failure	11 (2.2)	3 (1.5)	3 (1.8)	5 (3.9)	0.3
Asthma	44 (8.9)	24 (12.3)	9 (5.3)	11 (8.5)	0.06
Chronic obstructive pulmonary disease	20 (4.1)	8 (4.1)	3 (1.8)	9 (6.9)	0.08
Obstructive sleep apnea	28 (5.7)	15 (7.7)	5 (3.0)	8 (6.2)	0.1
Interstitial lung disease	12 (2.4)	7 (3.6)	0 (0.0)	5 (3.9)	0.04
Chronic kidney disease	13 (2.6)	5 (2.6)	3 (1.8)	5 (3.9)	0.5
Solid metastatic tumor	1 (0.20)	0 (0.0)	0 (0.0)	1 (0.78)	0.3
Charlson Comorbidity Index, median (IQR)	1.0 (1.0-2.0)	1.0 (1.0-2.0)	1.0 (1.0-2.0)	1 (1.0-2.0)	0.01
Patient-reported disease activity, mean (SD)	74.6 (19.9)	71.8 (20.9)	76.5 (18.1)	76.4 (20.30)	0.04

Abbreviations: bDMARD, biologic disease-modifying antirheumatic drug; BMI, body mass index; csDMARD, conventional synthetic disease-modifying antirheumatic drug; IQR, interquartile range; tsDMARD, targeted synthetic disease-modifying antirheumatic drug.

Table 2. Factors associated with greater COVID-19 risk perception (N = 494)

Demographic or Disease-Specific Feature	Unadjusted		Adjusted[a]	
	OR	95% CI	OR	95% CI
Age	**0.98**	**0.97-0.99**	**0.98**	**0.96-0.99**
Male (vs female)	0.93	0.59-1.45	1.25	0.78-2.06
White (vs non-white)	1.23	0.71-2.14	1.71	0.94-3.12
Any comorbidities	1.38	0.99-1.92	**1.60**	**1.09-2.36**
BMI	**1.03**	**1.00-1.06**	1.01	0.98-1.05
Ever smoker (vs non-smoker)	1.04	0.75-1.44	1.15	0.79-1.67
bDMARD (vs no bDMARD)	**1.94**	**1.31-2.88**	**1.75**	**1.14-2.68**
Glucocorticoid (vs no glucocorticoid)	1.36	0.94-1.97	1.37	0.91-2.08
Patient-reported disease activity	**0.99**	**0.98-1.00**	0.99	0.98-1.00

Abbreviations: bDMARD, biologic disease-modifying antirheumatic drug; BMI, body mass index; CI, confidence interval; COVID-19, coronavirus disease 2019; OR, odds ratio.
Bold indicates *P* < 0.05.
[a] Adjusted for all covariates

RESULTS

Of 1736 participants invited to participate, 587 (33.8%) participated and 494 (28.5%) reported a diagnosis of RA and are included in this analysis. The majority were female (418; 85%) and white (447; 91%); the mean (SD) age was 62.6 (13.8) years (Table 1). The majority were nonsmokers (256; 52%). Hypertension was the most common comorbidity (142; 29%) and the median (IQR) CCI was 1.0 (1.0-2.0). The median (IQR) number of health care visits within the MGB system in the last 6 months of 2019 (July 1, 2019, to December 31, 2019), preceding the pandemic, was 16 (8–29). At the time of the survey, the mean (SD) disease activity was 74.6 (19.9). The majority of participants had used a b/

tsDMARD (379; 77%) or csDMARD (309; 63%) in the 6 months preceding the pandemic; a minority (134; 17%) were on glucocorticoids. The most commonly used DMARDs were methotrexate (263; 53%), etanercept (116; 24%), abatacept (99; 20%), adalimumab (83; 17%), and hydroxychloroquine (91; 18%) (Supplementary Table 1).

A history of a COVID-19 infection was reported by 21 (4%) participants but was only confirmed by a polymerase chain reaction test in five (1%). In the remainder, a diagnosis of COVID-19 was made by the patient (9; 2%) or by a provider only on the basis of symptoms (4; 0.8%). Twenty-five (5%) participants were unsure whether they had had a COVID-19 infection. The remainder of participants (448; 91%) denied any history of known COVID-19 infection (Supplementary Table 2).

With regard to risk perception, 195 (40%) participants strongly agreed that their RA or its treatment put them at higher risk for COVID-19 or severe outcomes, whereas 169 (34%) agreed with this statement, and 130 (26%) were either uncertain or disagreed with this statement. In adjusted analyses, younger age (odds ratio [OR]: 0.98; 95% confidence interval [CI]:0.96-0.99; *P* = 0.007), any comorbidity (OR: 1.60; 95% CI: 1.09-2.36), and recent use of bDMARDs/tsDMARDs (OR: 1.7;5 95% CI: 1.14-2.68; *P* = 0.046) were associated with greater perceived risk (Table 2). Associations of sex, race, glucocorticoid use, smoking status, or body mass index with risk perception were not observed.

The majority of participants reported using at least one shielding practice (Figure 1), including quarantining (364; 74%), masks and/or gloves (474; 96%), or social distancing (485; 98%). Of those who quarantined, the vast majority (303; 83%) did so on their own accord, as opposed to it being mandated by their government. The majority of participants used all three measures (352; 71%), but this varied according to risk perception. Among those who strongly agreed, agreed, or were uncertain/disagreed
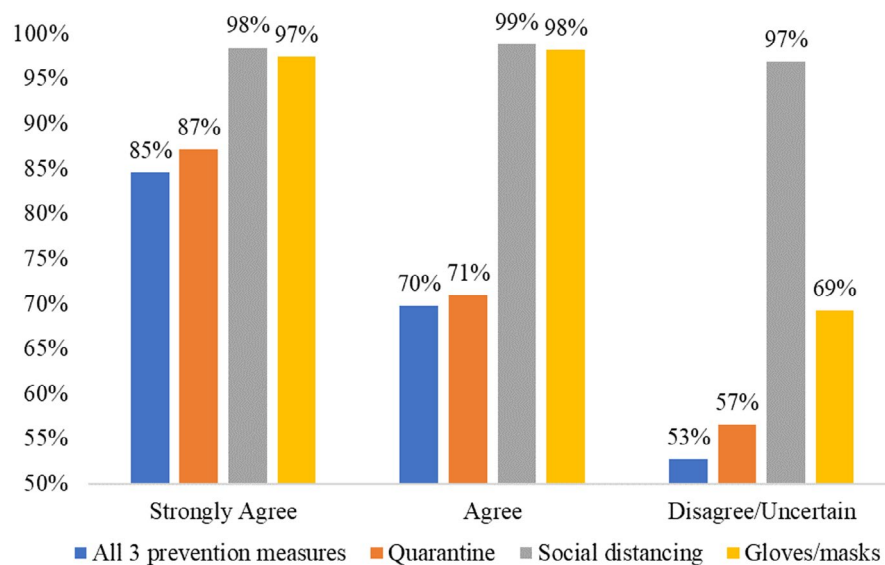

Figure 1. Risk perception and shielding practices (N = 494).

Table 3. The association of risk perception with using all three shielding practices

Demographic or Disease-Specific Feature	Unadjusted		Adjusted[a]	
	OR	95% CI	OR	95% CI
Risk perception				
Strongly agree	**4.86**	**2.89-8.18**	**4.16**	**2.37-7.29**
Agree	**2.05**	**1.27-3.29**	**1.97**	**1.17-3.32**
Uncertain/disagree	1.0	Ref	1.0	Ref
Age	0.99	0.99-1.01	1.01	0.99-1.03
Male (vs female)	0.85	0.50-1.45	1.13	0.60-2.12
White (vs non-white)	1.32	0.70-2.49	1.39	0.68-2.84
Any comorbidities	1.28	0.86-1.91	0.94	0.58-1.52
BMI	1.02	0.98-1.05	1.00	0.96-1.04
Current/prior smoker (vs non-smoker)	1.15	0.78-1.69	0.97	0.61-4.54
bDMARD (vs no bDMARD)	**1.79**	**1.14-2.80**	**1.76**	**1.06-2.90**
Glucocorticoid (vs no glucocorticoid)	**1.86**	**1.16-3.00**	1.70	0.98-2.96
Patient-reported disease activity	0.99	0.98-1.00	0.99	0.99-1.01

Abbreviations: bDMARD, biologic disease-modifying antirheumatic drug; BMI, body mass index; CI, confidence interval; OR, odds ratio. Bold indicates $P < 0.05$.
[a] Adjusted for all covariates.

that they were at higher COVID-19 risk because of RA, 165 (85%), 118 (70%), and 69 (53%), respectively, practiced all three shielding measures ($P < 0.0001$). Similar differences across risk perception categories were observed according to the use of masking/gloves and quarantining ($P < 0.0001$ and $P = 0.002$, respectively).

In adjusted logistic regression analyses, those who strongly agreed that they were at higher risk had a nearly fourfold higher odds of using all three shielding practices (OR: 4.15' 95% CI: 2.37-7.27) compared with those who were uncertain or disagreed with being at risk for worse COVID-19 outcomes (Table 3). Similarly, those who agreed with the statement had twofold higher odds of using all three shielding practices (OR: 1.97; 95% CI: 1.17-3.32). In adjusted analyses, bDMARD/tsDMARD users were more likely to practice all three shielding measures (OR: 1.99; 95% CI: 1.23-3.23) than non-bDMARD/tsDMARD users (Table 4). Glucocorticoid users were also more likely to practice all three shielding measures than non-glucocorticoid users (OR: 1.81; 95% CI: 1.06-3.08).

Several themes emerged from the free-text responses provided by participants (Supplementary Table 3). Themes included difficulty seeking health care, medications, employment, shielding behavior, exercise, mental health, and perceived risk of exposure. The majority (146; 53%) of the free-text comments referred to mental health themes (eg, anxiety, stress, and depression). Common subthemes among the mental health theme included reports of increased stress (34; 12%), uncertainty (33; 12%), and fear 32 (12%). Additionally, seven (3%) participants expressed an increase or emergence of depression during the pandemic, and 14 (5%) participants reported an increase or emergence of anxiety during the pandemic. There was an association between greater

perceived risk and self-reporting the effects of the COVID-19 pandemic on mental health by participants in the free-text responses ($P = 0.001$) (Figure 2).

DISCUSSION

In this study of participants with RA in the greater Boston area during the COVID-19 pandemic, we observed strong associations between several patient and disease-specific features with COVID-19 risk perception. However, these associations did not necessarily align with our evolving understanding of COVID-19 risk based on observational studies. Although the use of shielding practices was common in this study, there was variation in their use according to self-perceived risk. Given the ongoing uncertainty regarding factors associated with COVID-19 risk in patients with RA and reduced efficacy of SARS-CoV-2 vaccination in some DMARD users (12–14), these findings highlight the importance of patient education to ensure appropriate adherence to shielding practices.

Among patients with rheumatic diseases, several risk factors for severe COVID-19 have been identified, including older age, being male or non-white, comorbidities, higher disease activity, and the use of certain medications, particularly sulfasalazine, rituximab, and glucocorticoids (10,11,20). Compared with other treatments, the use of certain bDMARDs/tsDMARDs, especially TNFis, has been associated with better outcomes (20), whereas others, such as JAKis and rituximab, may be associated with worse outcomes (11). Of note, TNFis were the most commonly reported bDMARD/tsDMARD used by participants in this study, and there were few users of rituximab or JAKis. We found that younger age, having a comorbidity, and use of bDMARDs/tsDMARDs were independently associated with higher perceived COVID-19 risk among survey participants. Our findings regarding age and bDMARD/tsDMARD use suggest a discordance between risk factors for COVID-19 severity observed in prior cohort studies and those perceived to be risk factors by people with RA.

Table 4. Factors associated with using all three shielding practices

Demographic or Disease-Specific Feature	Unadjusted		Adjusted[a]	
	OR	95% CI	OR	95% CI
Age	0.99	0.99-1.01	1.00	0.98-1.02
Male (vs female)	0.85	0.50-1.45	1.16	0.63-2.14
White (vs non-white)	1.32	0.70-2.49	1.61	0.82-3.18
Any comorbidities	1.28	0.86-1.91	1.09	0.69-1.73
BMI	1.02	0.98-1.05	1.01	0.97-1.04
Current/Prior Smoker (vs non-smoker)	1.15	0.78-1.69	1.00	0.64-1.57
bDMARD (vs no bDMARD)	**1.79**	**1.14-2.80**	**1.99**	**1.23-3.23**
Glucocorticoid (vs no glucocorticoid)	**1.86**	**1.16-3.00**	**1.81**	**1.06-3.08**
Patient-reported disease activity	0.99	0.98-1.00	1.00	0.99-1.01

Abbreviations: bDMARD, biologic disease-modifying antirheumatic drug; BMI, body mass index; CI, confidence interval; OR, odds ratio. Bold indicates $P < 0.05$.
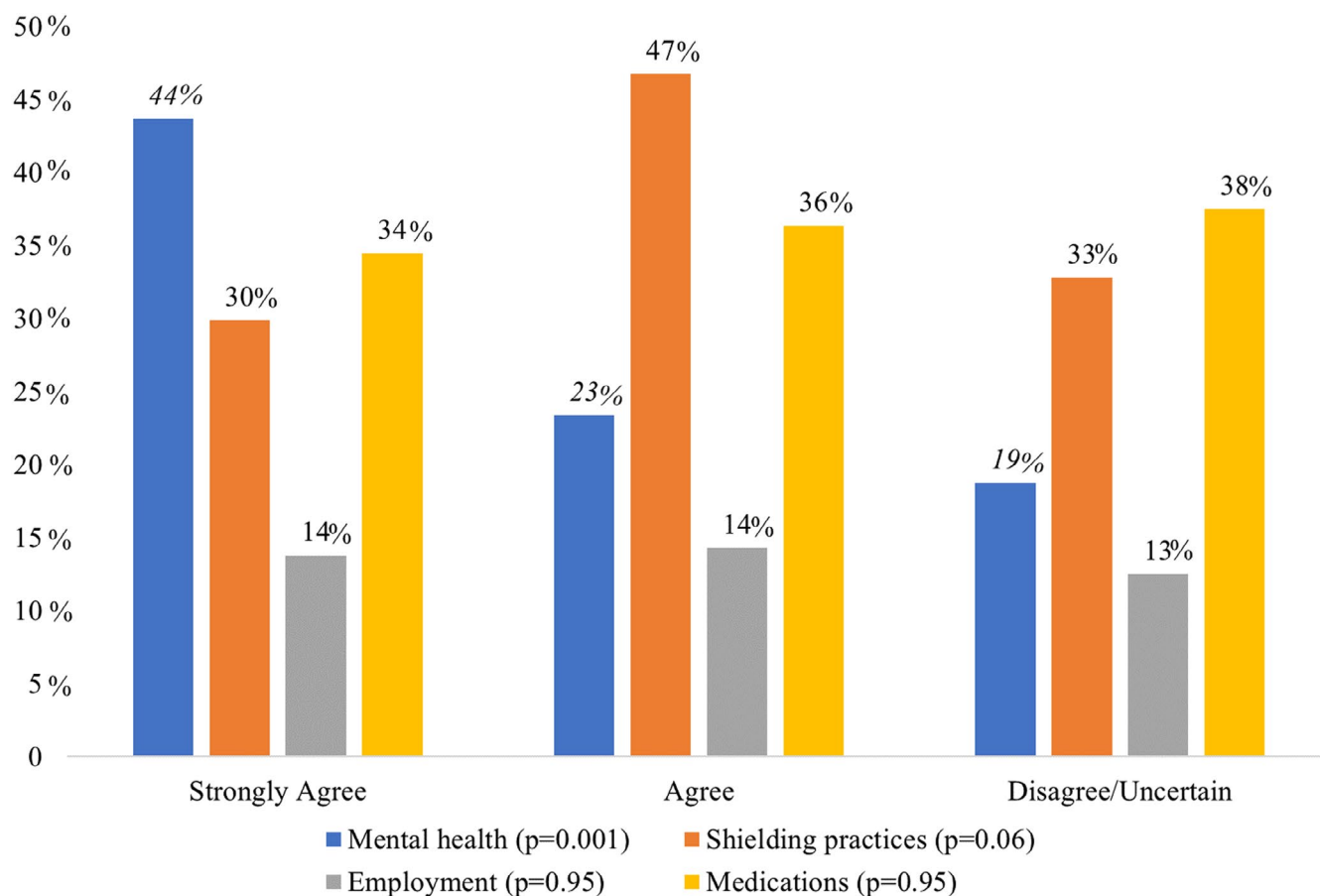[a] Adjusted for all covariates.

Figure 2. Risk perception and thematic analysis (N = 229).

Additional studies are needed to clarify this further, especially as our understanding of risk factors for COVID-19 outcomes according to specific bDMARD/tsDMARD classes continues to evolve. In the context of disrupted access to health care, during which patients may not have had the same level of contact with their providers (21), it is critical that the rheumatology community continue to educate our patients on risk factors for poor outcomes using a variety of methods.

This study expands on previous studies evaluating risk perception and shielding practices in participants with RA and other inflammatory diseases. A survey study of participants with inflammatory rheumatic diseases in Denmark conducted earlier in the pandemic (March to June 2020) reported a similar proportion of participants as in our study who expressed concern regarding their risk of COVID-19 infection (up to 75% during the study period) (22). However, a much smaller proportion of participants in the Denmark study reported "self-isolation" (up to 22% during the study period). Differences in the proportion of participants isolating or quarantining themselves may reflect contrasting rates of COVID-19 incidence in Denmark and the United States during the study periods as well as differences in recommended practices by the government. Similar to our observations, they found that bDMARD/tsDMARD users were more likely

to express greater risk perception and that DMARD users, in general, were more likely than non-DMARD users to quarantine. An international survey study of participants with psoriasis also found that bDMARD/tsDMARD users were more likely to use shielding practices (23). A survey study of patients with a variety of rheumatic diseases in Singapore also observed a cluster of patients with more worry about COVID-19 and greater shielding practices (24). The association of bDMARD/tsDMARD use with greater shielding practices observed across these studies may confound observations between bDMARD/tsDMARD exposure and COVID-19 risk and outcomes. The design of observational studies evaluating these associations will need to consider this potential confounder, which may be difficult to measure in certain data sources.

Our findings are particularly relevant because we also observed an association between perceived risk and shielding practices in a cohort of patients with RA in the United States such that those who perceived themselves to be at an uncertain or lower risk for COVID-19 or severe outcomes were less likely to practice strict shielding. Given our findings regarding the discordance of factors associated with risk perception and previously reported risk factors for severe COVID-19 in cohort studies, these differences in shielding practices are concerning because

they suggest that those individuals at higher risk for severe COVID-19 may actually be the ones less likely to adhere to strict shielding practices. Although shielding practices are critical to reducing risks of COVID-19 and controlling the ongoing pandemic, they do come at substantial personal and societal costs. Indeed, previous studies of the general population and participants with rheumatic diseases have established the negative impacts of the pandemic on mental health, including anxiety and depression, likely driven in part by the need for shielding practices, which contribute to social isolation (24–29).

Our study also has certain limitations. First, this study was conducted in the middle of 2020, following the first COVID-19 surge in the northeast United States. Therefore, patients' perceptions of their risk and shielding practices may have changed with the expanding evidence base as well as the recent introduction of vaccinations. However, our findings still remain relevant given the uncertain efficacy of SARS-CoV-2 vaccination in patients with RA receiving DMARDs and the ongoing evolution of our understanding of risk factors for COVID-19 and its severity in patients with RA. Second, people were invited to participate in this study because they received care in a large health care system in New England. The majority of patients in our study were white and completed the survey electronically. Collectively, these factors may limit the generalizability of our findings. However, MGB includes tertiary care facilities as well as community hospitals; moreover, a spectrum of disease severity and DMARD use was observed in this study. Additional studies are needed to evaluate whether these observations persist in populations with more racial, ethnic, and socioeconomic diversity. Third, as with any survey-based study, our findings are limited by potential recall bias as well as selection bias because participants may be those most likely to adhere to risk-mitigating strategies. Additionally, there is the possibility for social desirability bias such that participants may have been more likely to report shielding because they felt like to report otherwise would interfere with their relationship with their rheumatology provider. However, these surveys were conducted separately from clinical visits, and participants were assured that the results would not be shared with their providers. Fourth, the questions included in our survey, including those regarding risk perception, have not undergone formal evaluation of internal or external validity.

The factors associated with COVID-19 risk perception in participants with RA may differ from risk factors reported in observational studies. In particular, bDMARDs/tsDMARDs were associated with greater perceived risk. Those who perceived themselves to be at higher risk for COVID-19 or severe outcomes were more likely to follow strict shielding. These findings highlight the importance of patient education campaigns. Additional studies are needed to clarify factors driving risk perception and shielding practices and the impact of these risks and practices on mental health.

AUTHOR CONTRIBUTIONS

All authors were involved in drafting the article or revising it critically for important intellectual content, and all authors approved the final version to be published. Dr. Wallace had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.
Study conception and design. Cook, Zhang, Stone, Choi, Wallace.
Acquisition of data. Cook, Cox, Wallace.
Analysis and interpretation of data. Cook, Cox, Fu, Zhang, Wallace.

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